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November/December 1984
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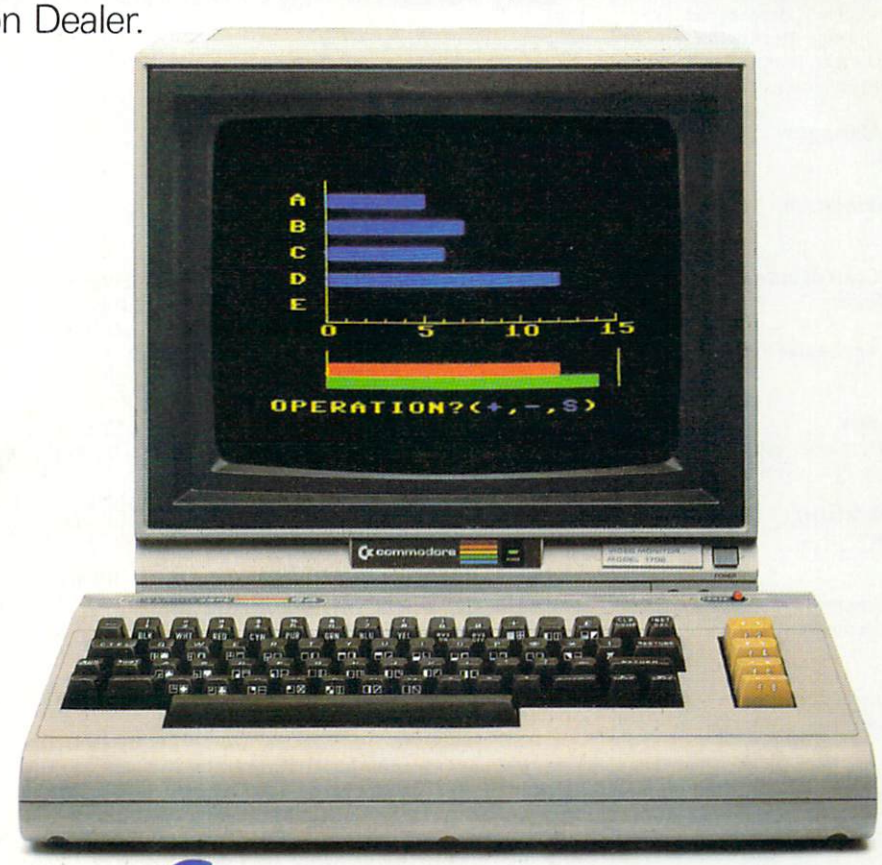

commodore COMPUTERS

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Watch For These Upcoming Issues

Power/Play, Issue 12 (December/January): Our special Christmas issue spotlights recreational and home applications software for Commodore computers. You'll also get an in-depth look at the best joysticks on the market. Which one will help you get a higher score?

Commodore Microcomputers, Issue 33 (January/February): Just how CAN your computer help you at home? True, it can't wash dishes. But if you do a little creative thinking and/or get some of the new home-oriented software that's now on the market you'd be amazed at how useful your trusty electronic companion can be around the house. Find out more in our first issue of 1985, focusing on The Home.

Key to Entering Program Listings

```
"[F1,F2,F3,F4,F5,F6,F7,F8]":F1,F2,F3,F4,
  F5,F6, F7 AND F8
"[POUND]":ENGLISH POUND
"[PI]"PI SYMBOL
"^":UP ARROW
"[HOME]":UNSHIFTED CLR/HOME
"[CLEAR]":SHIFTED CLR/HOME
"[RVS]":REVERSE ON
"[RVOFF]":REVERSE OFF
"[BLACK,WHITE,RED,CYAN,MAGENTA,GREEN,BLUE,
  YELLOW]" THE 8 CTRL KEY COLORS
"[ORANGE,BROWN,L. RED,GRAY 1,GRAY 2,L.
  GREEN,L. BLUE, GRAY 3]":THE 8
  COMMODORE KEY COLORS (ONLY ON THE 64)
GRAPHIC SYMBOLS WILL BE REPRESENTED AS
  EITHER THE LETTERS SHFT (SHIFT KEY) AND
  A KEY:"[SHFT Q,SHFT K,SHFT V,SHFT T,
  SHFT L]"
  OR THE LETTERS CMDR (COMMODORE KEY) AND
  A KEY:"[CMDR Q,CMDR H,CMDR S,CMDR N,
  CMDR O]"
IF A SYMBOL IS REPEATED, THE NUMBER OF
  REPITITIONS WILL BE DIRECTLY AFTER THE
  KEY AND BEFORE THE COMMA:"[SPACE3,
  SHFT S4,CMDR M2]"
```

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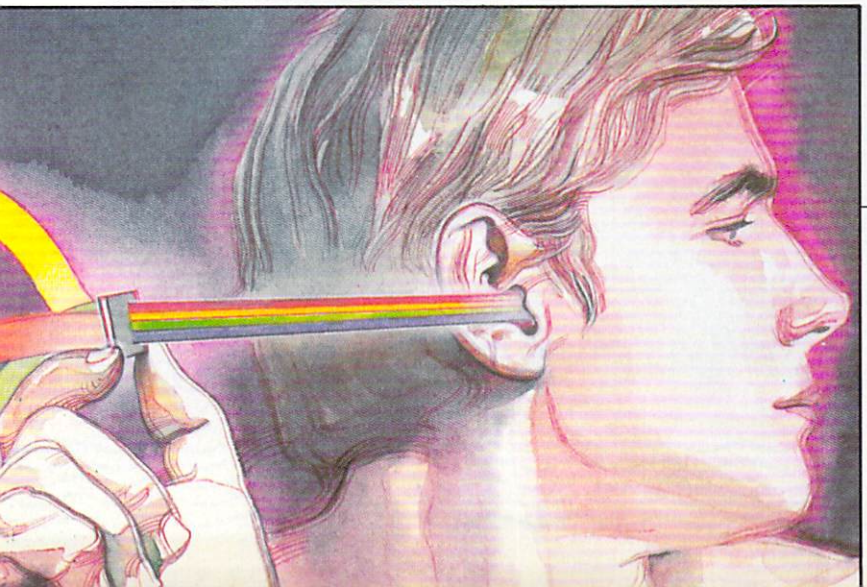

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Under The Big Top!

The 1984 Summer Consumer Electronics Show Stars the Commodore 64

By Peggy Herrington

McCormick West, a renovated warehouse, was filled with the latest computer hardware and software products—many of them for the 64.

Rivalling the Greatest Show On Earth, the 1984 Summer Consumer Electronics Show in Chicago proved to be the biggest trade show—if not the greatest—in the nation. A record-breaking 98,271 people jammed into McCormick Square in Chicago during the four days of the show to see the latest developments in audio-visual, communications and computers.

This high-tech carnival comes to town twice a year, alternating between Chicago in June (although rumor has it that the Big Apple is being considered for 1986) and Las Vegas in January, with the performers trying their best to dazzle the crowds with the acts and wares they've been working up in the interim. Net space for computer exhibits was up 25% over June 1983 and for the first time, computer hardware and software filled the McCormick West, a three-story renovated warehouse near McCormick Place. Even with all this new space, the "tent" bulged at its seams.

Buses, cabs and private vehicles delivered thousands of visitors each morning. As we shouldered our way through McCormick's portals, uniformed guards checked ID badges and hawkers cried of newsbreaking show events as they thrust free trade publications at us like birds feeding their young. Once inside the vast display halls of McCormick West, the noise and press of the crowd intensified with the babble and music of computerized games, voice synthesizers and the assorted sounds of showmanship. Banners, balloons, oversized posters and multi-story booths colored the vista (did it really turn hazy in the distance?). Despite the absence of cotton candy, and sawdust, at times it was a real three-ring circus!

Still, through all the flash and dazzle, even a cursory tour of McCormick West revealed the Master of Ceremonies of this show; the force behind the bustle was none other than the mighty Commodore 64. The vast majority of the 225 hardware and software exhibitors in McCormick West showed wares which displayed the 64's talents. In fact, the CES Software Showcase, an assemblage of 94 computer and video programs judged by a panel of industry experts to be the best of the year, was clearly dominated by software for the 64.

You don't have to take my word for it—come and see for yourself. Grab some popcorn and a seat in the bleachers. Don't dawdle. The house lights are dimming and several spotlights are focusing on Ring Number One. Any minute now, the emcee of the 1984 Summer Consumer Electronics Show, Miss Commodore 64, will appear to proudly introduce you to the movers and shakers of the show. Wait! Here she is now!

"L-a-d-eees an' Gentlemun! Welcome to the Greatest (Computer) Show on Earth, the 1984 Summer Consumer Electronics Show! Our first event will be the grand Parade of Hardware from some of the most innovative, imaginative and productive digital designers in the nation—nay, in the world! Quiet down because here comes our first exhibit now!

"We begin the parade with one of the most exciting pieces of hardware at the show, Okidata's new dot matrix printer, the Okimate 10, which prints not only letter quality text at 240 words per minute, but dot-addressable graphics as well, at 60 characters per second in full color with over 40 varying hues. And it will print either style on any kind of paper. The Okimate 10 comes with inter-

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"... facts attest to its

EXCELLENCE!"

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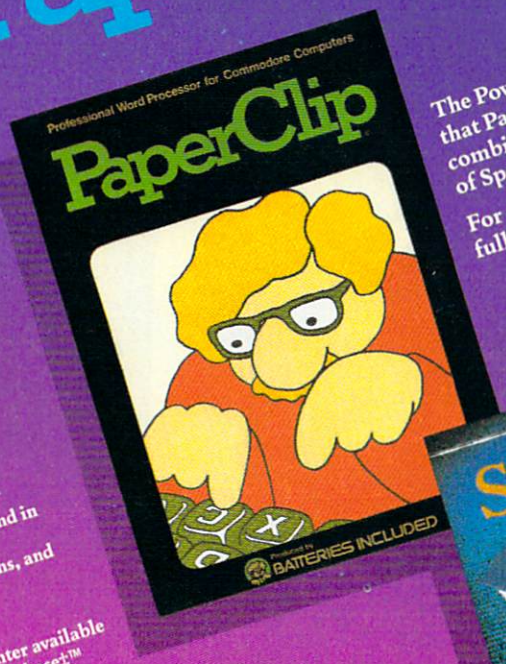

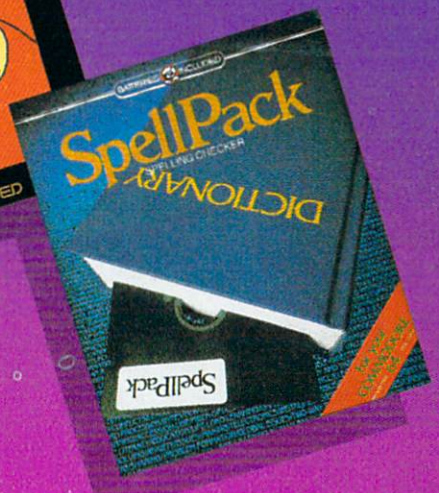

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face, software, color and black ribbon cartridges, connector cables, handbook and sample paper, all for the retail price of $239. That's right, folks, $239, complete!

"Our second colorful offering is from Koala Technologies (makers of the well known KoalaPad), in cooperation with Henson Associates (of Children's Television Network fame) and Sunburst Communications (designers of award-winning educational software), who now bring you the Muppet Learning Keys, a 14" × 15" keyboard bypass tablet for preschoolers. Connecting through the joystick port on the 64, this kid-sized lap tablet lets Kermit the Frog, Miss Piggy, Gonzo and Fozzie Bear help kids learn the alphabetically-arranged keyboard, water color set, compass and eraser features. Retail price is $79.95.

"Another graphics tablet being shown here for the first time is Super Sketch from Personal Peripherals. Based on a technology which differs from a touch-sensitive pad, Super Sketch is operated with a moving stylus control arm attached to the tablet and allows not only free hand drawing, but tracing as well. A small, deletable menu appears on the screen being created. With a cartridge, the VIC 20 version is $49.95 and my version is $59.95. Optional software includes *Super Music Box* ($19.95), *Business Presentor* ($39.95), *Master Home Planner* ($49.95) and *Printer Utility* ($29.95).

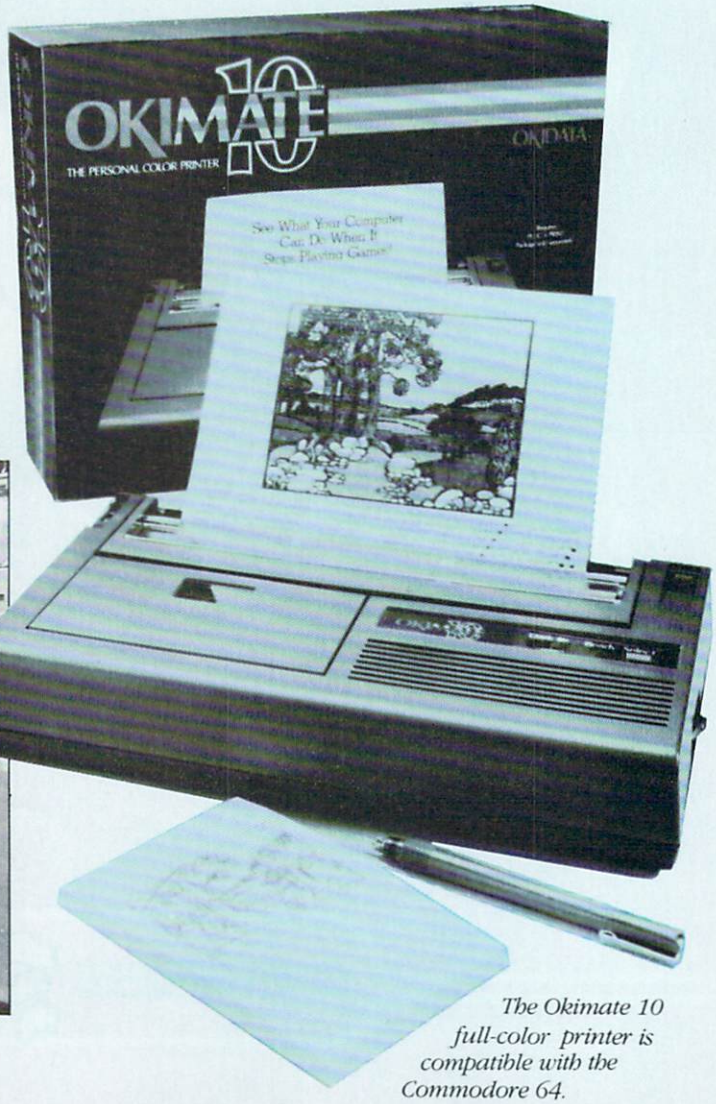
"And now, ladies and gentlemen, let's look at some hardware that's just begging to be talked about, a different keyboard bypass technology here at the show: Eng Manufacturing's voice recognition unit, Chirpee, which retails for $179.95. Chirpee can be trained to recognize specific voices in any language, English to Swahili, because it is based on phonetics and makes menu selection and simple commands easy. Although it's not there yet, this is the technology which we believe will usher in a new age of voice-commanded word processors and spreadsheets.

"Batteries Included will make it easier on your eyes with their new 80-Column Adaptor, the next item in our grand parade. This plug-in module (retail $199.95) makes it possible to switch my normal 40-column display to 80 columns (and back) for crystal clear visibility with a Commodore color monitor or any monochrome video monitor and comes with powerful 4.0 BASIC built in. Right behind that in our parade is an advanced version of the Batteries Included IEEE BusCard, now called BusCard II, which lets you use any Commodore-compatible serial disk drive, including hard disk and virtually any printer. Also built in are a standard Centronix parallel printer interface with selectable conversion of Commodore code to standard ASCII, machine language monitor and extended BASIC. Retail is $199.95.

"Our next act, while not a new peripheral or keyboard bypass, is an intriguing new product in ergonomic computer furniture. It's called the Back Chair from British Design (U.S.A.) Corp. Not having had any personal experience with chairs, I cannot testify to the utility of this backless chair which forces the user to distribute the weight of the body between the leg support and the, uhmm, posterior, thereby taking body weight off the lower lumbar region. Experienced sitters report that it prevents backache and fatigue, improved efficiency and provides a healthful and comfortable position for long computing sessions. Available in oak wood veneer or tubular steel with a chrome finish, the Back Chair is priced well below $100, unassembled.

"Speaking of computing sessions, here comes the next item in our parade, a relative of mine, the new Commodore

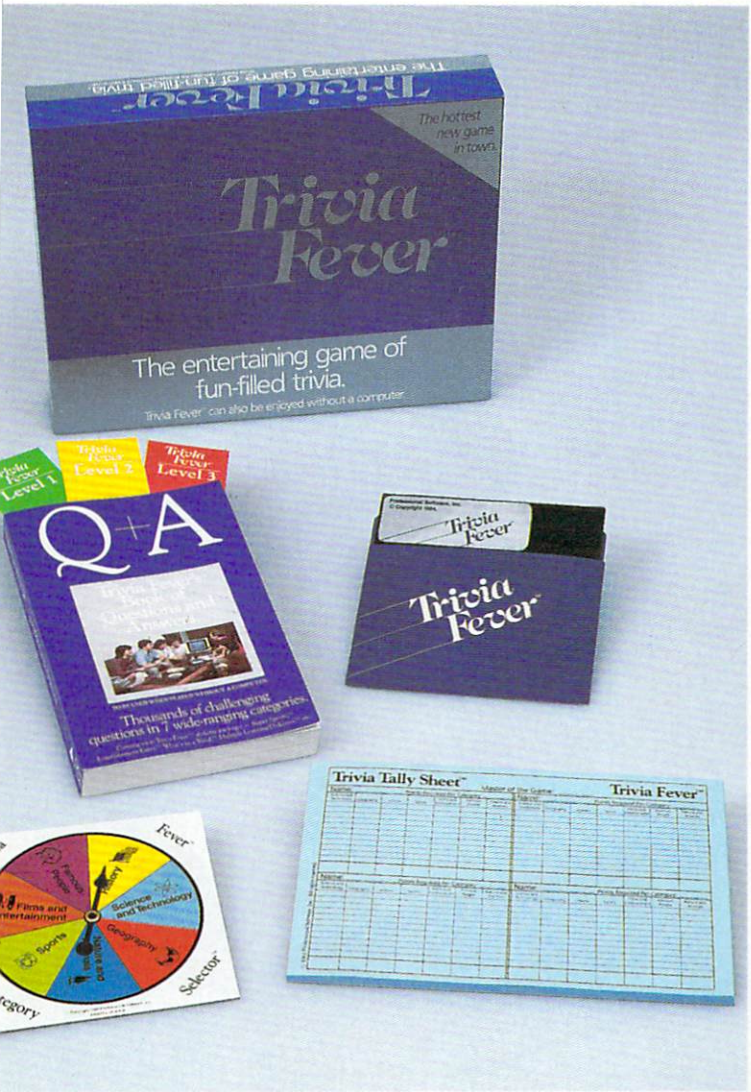
Commodore's booth at CES drew large crowds.



The Okimate 10 full-color printer is compatible with the Commodore 64.

Catch Trivia Fever™

"The Hottest New Game In Town"



Trivia Fever is absolutely unique — it's the only software entertainment package that can be enjoyed ***with*** or ***without*** a home computer! When played on your home computer, Trivia Fever is a refreshing alternative to all those shoot'em up games. An elected "Master of the Game" uses the computer to randomly select subject categories, handicap players, generate questions and answers, keep score automatically, and more! Instructive by its very nature, Trivia Fever can be enjoyed by up to 8 individuals or teams. And when played without a computer, Trivia Fever has all the best features of the "popular" trivia games plus more — all without the cumbersome board, cards, and little game pieces. You can play in a car, on vacation, anytime, anywhere! And Trivia Fever is by far the best Trivia game available anywhere. Here's why:

Trivia Fever offers thousands of challenging questions in 7 interesting categories, so there's something for everyone. Each category has questions with 3 levels of difficulty, which score comparable points. What's more, Trivia Fever allows players to HANDICAP all those so-called "trivia experts" three different ways, giving everyone a chance to win. And players can easily control the length of play from quick thirty minute games to multi-hour party marathons!

Trivia Fever is unique, entertaining, educational, and most of all FUN. And at $39.95, Trivia Fever is destined to quickly become the best selling software entertainment package of all time. There's even a $5 rebate available to any non-computer users who return the computer diskette.

Trivia Fever can be enjoyed on the Commodore 64, IBM PC & PCjr and compatibles, Apple II series, and others. So don't delay. Catch Trivia Fever at your favorite software retailer today!

For additional information call 617-444-5224, or write to:

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At $39.95, Trivia Fever comes complete with Question and Answer Book, Category Selector, and Tally Sheets to be used when played without a computer.

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Plus/4 productivity computer. I'm not concerned about the Plus/4 usurping my place in your hearts and homes even though it has four builtin integrated programs: word processing, spreadsheet, database management and graphics. Nor does it bother me that there's 60K usable RAM with resident enhanced BASIC (over 75 commands), screen window capability, split-screen text with high-resolution graphics, builtin machine language monitor, two tone generators, 128 colors and a HELP key. Furthermore, I couldn't care less about the matching CM 141 color monitor or DPS 1101 letter-quality daisy wheel printer, either. Why am I so nonchalant? Because the Plus/4 is a productivity machine and doesn't have sprites or the SID music synthesis chip.

"Winding up our Parade of Hardware tonight is my new little cousin, the Commodore 16 computer. This snappy little learning machine is just the thing for edging into computer literacy with its 16K bytes, builtin BASIC 3.5 with graphics and sound commands, machine language monitor, screen window capability, and cartridge-based instructional software which successively introduces more complex ideas. Completing the new Commodore 16 system is the very affordable, matching MPS 803 dot matrix printer and 1531 cassette.

"And that concludes the Summer CES Parade of Hardware. After a brief intermission we'll return with—but wait! What's that rolling onto the parade circuit under its own power? Could it be—no, surely it isn't! Yes, ladies and gentlemen, yes, it is! It's the personal robot from Heath/Zenith—it's Hero Jr.! And he's coming right toward us. Do you suppose he can talk?"

"I am Hero Jr, your personal robot. I have six personality traits which you may personalize to suit your desires. Or you may create your own. Are you a Robot Wizard?"

"Well, folks, as you just heard, he can indeed speak. Perhaps he has been programmed to tell us more.

"Junior, what do you have to say for yourself? Hmmm. No reply. Maybe I should tap his case. . . ."

"I am Hero Jr., the world's first affordable, preprogrammed personal robot. Although no programming skills are necessary on your part for me to wake you up in the morning, guard your home with a coded security system, play games, recite poetry and seek out human companionship, I can be interfaced to the 64 with an RS-232 interface and programmed through my BASIC cartridge. I come fully assembled for only $1,000. I also have a wireless remote control which enables you to operate me manually."

"Thank you, Junior.

"And there he goes, folks. What's that he's singing? Sounds like 'Daisy, Daisy' but I can't be certain.

"I do believe that's the conclusion of tonight's Grand Parade of Hardware. But don't head for the Midway yet, ladies and gentlemen, there's more excitement in store for you right here. I'm sure you'll enjoy this brief intermission while we set up for our next event, the CES Personal Productivity Software Arena."

Our emcee's reference to the midway at CES was not entirely for atmosphere. Accompanying the mainstream of Commodore compatible hardware and personal productivity software were some very interesting side shows.

For instance, there was a booth for what was surely every magazine printed in English (and a few that weren't), including *Playboy*, featuring a resident Bunny autographing the centerfold. The Epyx display sported live break dancers and Professional Software's *Trivia Mania* gave away prizes to contestants who knew the most about the least.

At the end of each day, aching from head to feet (ooh, the feet!), accompanied by musical groups stationed along the way, thousands of us pushed and shoved our collective way through a tunnel-like affair which was actually a long, subterranean walkway along the side of McCormick Hall, to stand in line for a ride home. That was when the real excitement began. Traffic in the third largest city of our nation is stupendous.

But let's get back to the show. . . .

"Welcome back to the second half of our presentation, ladies and gentlemen! Let's get right into the part of the show that will help us organize and simplify our lives—come with me now to the CES Personal Productivity Software Arena!

"Two topics which are in the public limelight these days are health care and personal computing and the first two products in our arena involve both: computer programs for managing stress.

"Let's run the first program which is from Batteries Included called *Stress Manager* (retail $79.95). Both this package and the one from Human Engineered Software called *Calmpute* ($89.95) are designed around GSR or the Galvanic Skin Resistance biofeedback method of measuring fluctuations in the skin's electrical conductivity. They work just like lie detectors! This is accomplished by a small hardware unit which collects information from the user's hand and transmits it to me for analysis and interpretation on my monitor. The *Stress Manager* includes an audio cassette which suggests methods of relaxation and stress reduction. *Calmpute* features a game called Calm Prix. The racing car moves faster when the user is relaxed and slows down as stress increases.

"The next group of software in the Arena addresses stress, too, but indirectly. This group is aimed at making programming easier and more productive.

"HES offers *Graphics BASIC* ($29.95), a utility which makes my sight, sound and motion (that means animation!) capabilities more accessible by extending my resident BASIC programming language by 48 commands. You can create programs with dynamic graphics and sound or chart business trends with graphics that incorporate split screens (part text, part high-resolution graphics) and windows. It also has a builtin sprite editor.

"Activision, Inc., is previewing their newest utility, the Activision Pencil (a working title), which was available on disk ($31.95) and cartridge ($34.95) as of this fall. This software lets you create graphics and sound illustrations while learning the basic elements of programming and requires no computing experience to start. You choose whether to use the keyboard

A new BusCard from Batteries Included enhances use of the 64.

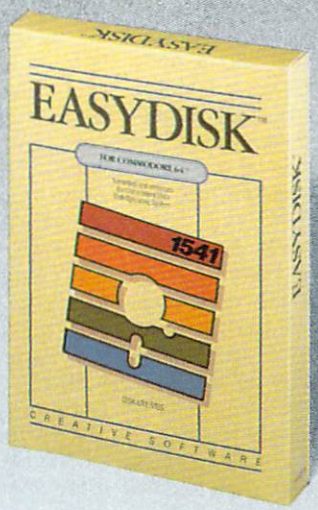
TWO SURE WAYS TO GET MORE OUT OF YOUR COMMODORE 64

I AM THE C-64 provides you with a friendly and patient private tutor. This series is the perfect guide to learning all the power your Commodore 64 has to offer.

- Complete six-volume series.
- Each operation you can perform is explained in simple terms right on the screen; no more struggling with confusing manuals.
- Includes overall introduction to the Commodore 64 and its keyboard.
- Learn BASIC programming language as well as advanced programming techniques.
- Advanced series guides you through music and sound effects and sprite graphics.

EasyDisk eliminates disk based aggravation. It saves time and adds extra features, all at the touch of a key. A must for all Commodore 64 disk drive owners.

- Simplifies the Commodore 1541 Disk Operating System.
- Organizes all the commands in a simple, easy-to-follow menu.
- Allows you to select and execute commands with just a few simple keystrokes.
- Provides full disk backup (using just one drive).
- Doesn't interfere with the normal operation of your computer; it's simply there when you need it.



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or do everything with a joystick. There are two main screens: from the first screen, with 75 graphic and musical commands, you select what you wish (this is how you write a program). The second screen is a canvas, with yellow pencil which executes those commands.

"Another group of programs in this category comes from a company that specializes in programs that write programs: CodeWriter. If you already know how to bit map and split screens, animate sprites, flip pages, handle files and program SID, CodeWriter's new *ActionWriter* (retail $49), *AdventureWriter*, *ELF System* and *Dialog* ($59.00 each) may be of limited interest to you. On the other hand, should you not have the time or inclination to write software in machine code, you might want to check into these utilities, which allow you to write everything from arcade-style games to spreadsheets—in English.

"Personally, I don't see what's wrong with machine code; I think in it, you know. All software written with CodeWriter utilities is freestanding and you can do whatever you want with it, including offering it for sale to software distributors or back to CodeWriter, who, incidently, is sponsoring a contest with wonderful prizes for the winning programs developed with their programs.

"Let's look now at a couple of programs designed to make my 1541 disk drive easier to work with. *EasyDisk*, a new offering from Creative Software ($29.95), enhances and extends the operating system of the 1541 with a program and sequential files and display them on the screen. It is accessed by a keystroke.

"And over here, Datamost is showing their new 1541 disk drive utility program, *KWIK-LOAD* ($19.95), which makes the 1541 load most programs into my RAM at a rate three times faster. *KWIK-LOAD* will copy individual files or a complete unprotected disk three times faster with one drive and five times faster with two drives. It also features disk editing to rename, delete and undelete files, validate and format disks, edit any track or sector, print out sectors and get a directory of the disk.

"Now let's go over to another part of the arena which is set up for one of my favorite endeavors, telecomputing. Communicating with other computer users and bulletin board systems is even more fun now that I can handle graphics.

"Yes, you heard me correctly, ladies and gentlemen, graphics! With the introduction of Commodore's *Videotex 64* (which uses the powerful new NAPLPS standard instead of traditional ASCII), you can create business graphics or other pictures in high-resolution color and combine them with text before transmitting them over regular phone lines with a modem to another user or BBS with *Videotex 64*.

"Just think of the business possibilities—diagrams, slide shows, bar graphs and even maps can be designed by real estate brokers, interior designers or advertising executives in San Diego and instantly transmitted directly to a client in Boston.

"Ease of telecommunications is determined, as you probably already know, by both a modem (hardware) and a terminal program (software). HES is showing two new telecommunications packages designed for me which will run on the VIC 20 as well: *Modem I* ($74.95) and *Modem II* ($119.95). Both packages feature a modem with sophisticated terminal software and the latter incorporates automatic dial and answer functions.

" *Phone Call*, a new full-featured terminal program from Arrays, Inc./Continental Software ($49.94) without a modem, permits, among other exciting features, uploading and downloading of machine language programs."

Batteries Included's new card produces a good 80-column display on the Commodore 64.

"And over here is *EasyComm 64*, a new terminal program from Commodore, which uses CompuServe's exclusive 'B" protocols for 100% error detection and correction, a 32K RAM buffer, printer support and ten programmable function keys.

"Another new terminal program on display here in our CES arena, *HomeTerm*, is part of a three-in-one package from Batteries Included. The package, called *HomePak*, consists of a fully-integrated smart telecommunications terminal, an information management system and a word processor—all on one disk for $49.95. Each of the three *HomePak* programs is capable of reading files created by the others. *HomeTerm* has an unlimited capture buffer, an onscreen clock to keep track of log-on time and a text editing window for simultaneous text creation and reception.

" *HomeText*, another of the three programs on Batteries Included's *HomePak* (the third is *HomeFind*, an information manager), leads us to the word processor display in our arena. *HomeText* has a full screen editor and a cut-and-paste facility for moving text. It supports most major printers, has user changeable text, background screen colors and a graphic preview mode to show how each page will appear on paper.

"A new professional quality word processor, *Super-Text* ($99.00), is being demonstrated here by Muse software. Based on *Super-Text* for the Apple, this version offers screen editing with onscreen instructions, an 80-column preview display, automatic word wrap, single key commands, multiple file search-and-replace and other advanced features.

"A third new word processor here at the show, *Creative Writer*, is part of a series of new productivity packages from Creative Software. *Creative Writer* offers help screens, headers and footers, search-and-replace, easy movement of text and document previewing while being fully integrated with *Creative Filer*, *Creative Calc* and *Creative Finance* ($49.95 each).

"Knowing how to type is necessary for using a word processor to its advantage, but it's even more important in telecommunications when you can't afford to hunt and peck at leisure. *Learn to Type* ($39.95) from Arrays, Inc./Continental Software, should be of interest not only to the executive who still picks at the keyboard, but to educators, because it can record the ongoing process of up to 30 students at one time. In addition to 25 builtin varying skill level lessons, *Learn to Type* allows the creation of drills to address specific problems and teaches standard qwerty and

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the new experimental Dvorak keyboard as well.

"A new self-paced typing tutor program from Batteries Included is here at the show, called *Keys to Typing*. This program teaches traditional typing skills plus an orientation to computer keys and is a part of Batteries' new Vista Learning Software Library for students and adults.

"What was that someone just shouted from the grandstand? Learning to type is one thing, you say, but what if you can't read? Well, you come right over here in our arena, sir, and check out *Evelyn Wood Dynamic Reading*, a new double-disk program from Timeworks, Inc. ($69.95). It's actually for improving reading skills, of course, based on the well-known speed reading course of the same name and is designed for teens and adults. One disk contains the operating programs and the other has text and comprehension quizzes for the reading exercises. Quiz results are automatically recorded and bar charts can be called to the screen to show the results of study and practice.

"Timeworks also has on display here in our arena seven, new expanded versions of their business systems software, which include inventory management, sales analysis, accounts receivable and invoicing, accounts payable and check writing, payroll, cash flow and general ledger. Retail is $59.95 for each program. Owners of the original packages can exchange them for the new versions at no additional cost.

"On the subject of business software, Commodore is introducing *B/Graph* here at the show, a new program which enables professionals and home users alike to turn any statistical information into three-dimensional graphs. *B/Graph* is especially well suited for business presentations or seminars. Features include simple screen color control, multiple graphs and grid overlays, automatic labelling and a menu-driven display structure.

"We also have some fine new software here in the arena designed for personal financial management and home productivity. The Scarborough System is demonstrating a new program to manage, track and organize a family's financial affairs. *Your Personal Net Worth* ($79.95) has a Susan B. Anthony silver dollar on the package and contains an excerpted edition of Sylvia Porter's *New Money Book for the 80's*. It allows you to set up a budget for 350 different categories, will handle up to ten checking accounts (and print checks for them), a substantial number of credit cards, track tax deductible expenditures and display or print financial reports. The program records stock and other investment transactions, documents household valuables and collectibles and will also record their locations. If you don't like the end result—an up-to-date report of your personal net worth (a balance sheet of assets and liabilities)—you might want to look into our next program.

"Arrays, Inc./Continental Software is introducing four volumes in a new series of personal financial planning programs. Designed to teach basic money management skills, volume one, *Get Rich: Strategies* is a set of financial tools to direct the user in accumulating greater wealth or in planning any number of money-related "what if" situations. Worksheets are provided for setting goals and calculations and graphs analyze the performance of investments, interest rates and other related matters. Results may be printed out. Working in tandem with volume one, three additional volumes offer financial guidance for real es-

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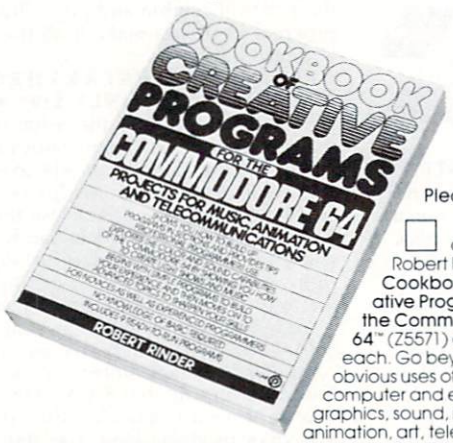

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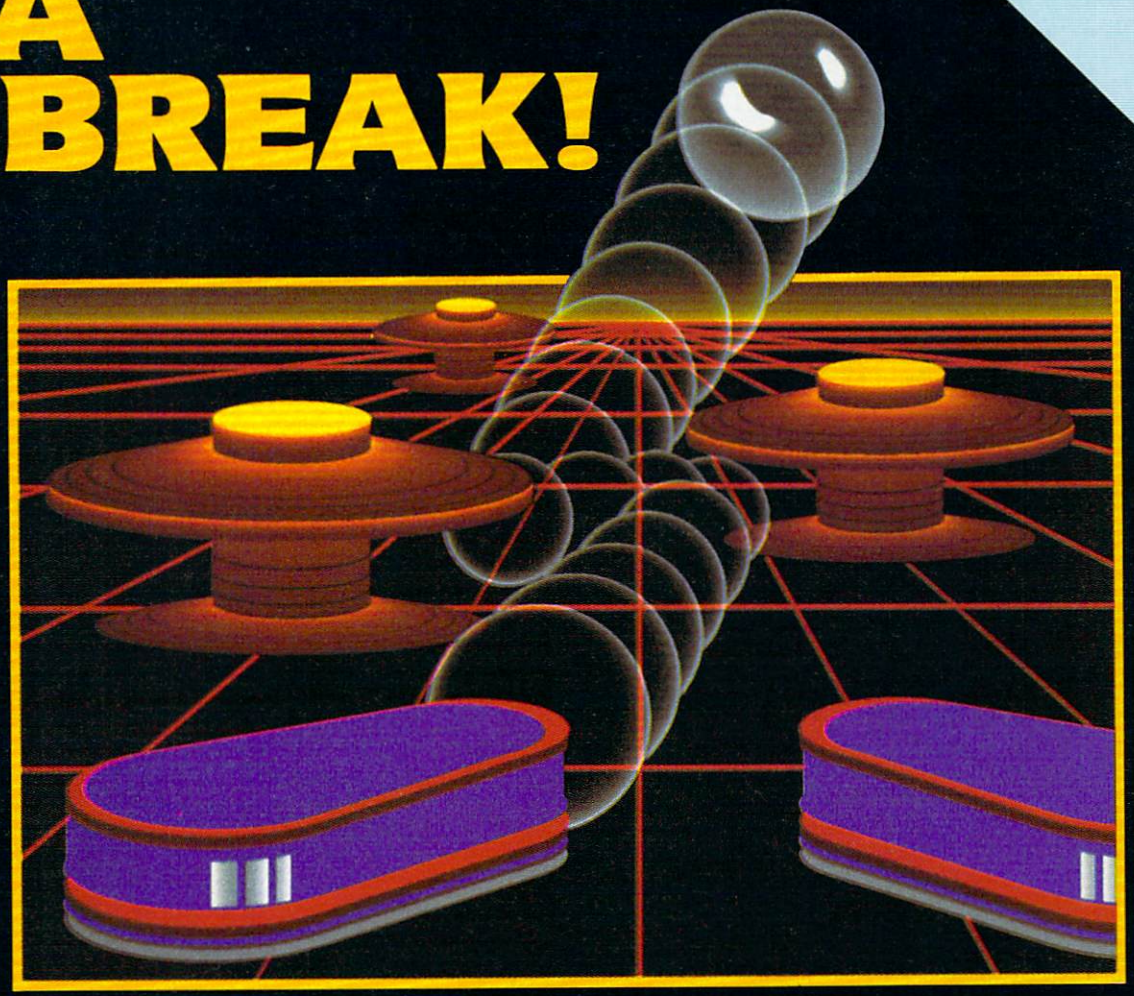

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"The *Home Executive* ($49.95) from Superex Home software is the last (but, as you will see, definitely not the least) exciting productivity package on display. This package includes nine programs, all with report generators: the *Address Book*, *Appointment Book/Calendar*, *Checkbook*, *Collector's List*, *Household Inventory*, *Gift List*, *Expenses*, *Portfolio Manager* and the *Financial Analyst* which consists of four subprograms: *Loan Analyzer*; *Monthly Deposit*, a program which calculates compound interest; *Monthly Annuity* to determine how much of an initial investment to make in order to withdraw a monthly amount from retirement accounts, for example; and *Future Value* which calculates how much an investment will be worth at a future time.

"And that's our show, folks! Please feel free to come down into the arena and look over this exciting assortment of new hardware and software products—and don't forget the sideshows and the midway. We hope to see you again soon, next time from the glitter-capital of the world, Las Vegas, Nevada, for the 1985 Winter Consumer Electronics Show. Thanks for joining us Under The Big Top. Until next time, happy computing!"

Get Creative With New Commodore-Compatible Hardware Products

By Danny Byrne

Commodore computers—especially the Commodore 64—have become the darlings of third-party hardware developers. In fact, Commodore-compatible disk drives, printers, musical keyboards, graphics tablets, light pens, modems and monitors are being created at a startling rate. I'd like to give you a look at some of the newest products, many of which were introduced at the Consumer Electronics Show last June but have only recently begun to show up on dealer's shelves.

One such product is Koala Technology's Muppet Learning Keys—a child's plug-in keyboard for the Commodore 64. Every function of the Learning Keys is accessed by pressing an icon that is shaped like a familiar object, such as a chalkboard, ruler, eraser, paintbox and even a comic book. According to David Thornburg, chief scientist at Koala, the icon for the space bar key, which is depicted as a comet shooting into the sky, gave the designers a few sleepless nights.

"I guess you could say that it is an inside pun (space, as in outer space)," David told us, "but it was the only thing we could come up with that a non-reading child might understand."

The keys on the Muppet Learning Keys board are arranged in a grid 11 keys wide and nine keys high. I noticed that some of the keys did not have a corresponding icon, but I was told that there were plans to come out with overlays the user would slide in for specialized functions. The Muppet Learning Keys is a joint project of Koala Technologies, Sunburst, producers of award-winning educational software, and Jim Henson from Henson Associates, creators of the Muppets.

Also from Koala you can soon expect the Gibson Light Pen for the 64. I had the opportunity to talk to Mr. Gibson briefly about the 64 version of the light pen software that he was currently working on. He says he has nicknamed the Commodore version the "Intimidator" because of the effect it will have on anyone trying to duplicate its functions. He talked of windows, pull-down menus and animation. He enthusiastically told me that the 64 had enormous untapped abilities that had enabled him to produce the graphics effects. He also said that the 64 was his favorite machine (so far)—high praise indeed!

Batteries Included recently announced their 80-column card and the BusCard, an IEEE interface. I saw the 80-column card running their *PaperClip* word processor and it displayed a nice, crisp picture. The characters were very distinct and easy to read.

Another first at the show was a product called Chirpee, from Eng Manufacturing. Chirpee is a voice recognition module that plugs into the 64 and will allow users to program voice commands into their computer software, training the computer to recognize its master's (or mistress's) voice. One of their demonstrations showed balloons floating across the screen, not unlike the sprite balloon demo in the 64 users guide. The balloons floated higher as I recited vowels from the alphabet into the hand-held microphone. Each balloon was linked to a different vowel and as I enunciated the vowel, the balloon floated higher on the screen. I can see tremendous applications for this low-cost voice recognition system, especially in educational software.

One of Chirpee's designers, Mark Shaw, Eng Manufacturing Vice President of Engineering, assured me that Chirpee may be easily used in your own programs. I suspect we will see much more of this product in the near future.

Voice Master from Covox is another plug-in module. The difference is a voice digitizer, which allows users to record their own voices into the computer and onto a floppy disk for later playback or use within a program. No hardware is needed for playback and the product is already being used in educational software and for creating voices for the handicapped. Other types of synthesis are already in use that allow the handicapped to verbalize, but at last a child can speak with a child's voice, rather than sounding like a robot or, at best, an adult.

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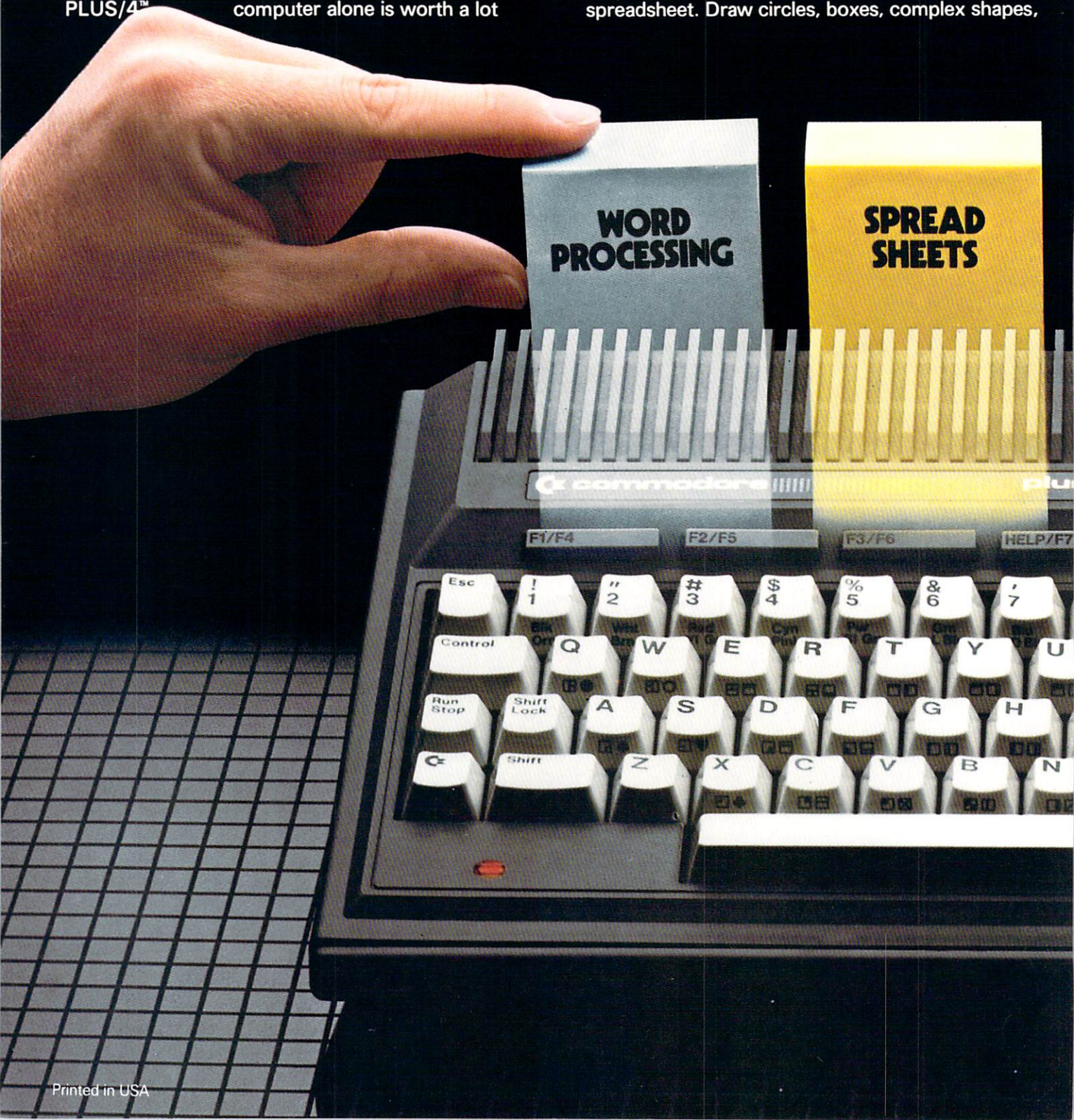

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own voice coming from the 64. The cartridge plugs into the user port and comes with microphone and a disk with the entry program, as well as a couple of sample programs. All this for less than $100. It is beginning to look as though computers conversing with their owners will become an everyday occurrence.

MSD is presently marketing the SD-2 (SD stands for Super Drive) disk drive for the Commodore 64. The SD-2 is a 4040/1541-compatible dual drive, which is good news for anyone who needs a dual drive, now that the 4040 isn't being manufactured by Commodore any longer. There seem to be very few problems with software compatibility, and those software houses whose products had a problem loading into the MSD drives did say they were addressing the issue.

The SD-2 dual drive will format a disk in approximately 17 seconds and will do a complete backup in less than two minutes. The backup is simply done using the command: open15,8,15,"D1=0". The destination disk in drive one will become exactly the same as the source disk in drive zero. I currently have an SD-2 for evaluation and I love it. It's a real spoiler!

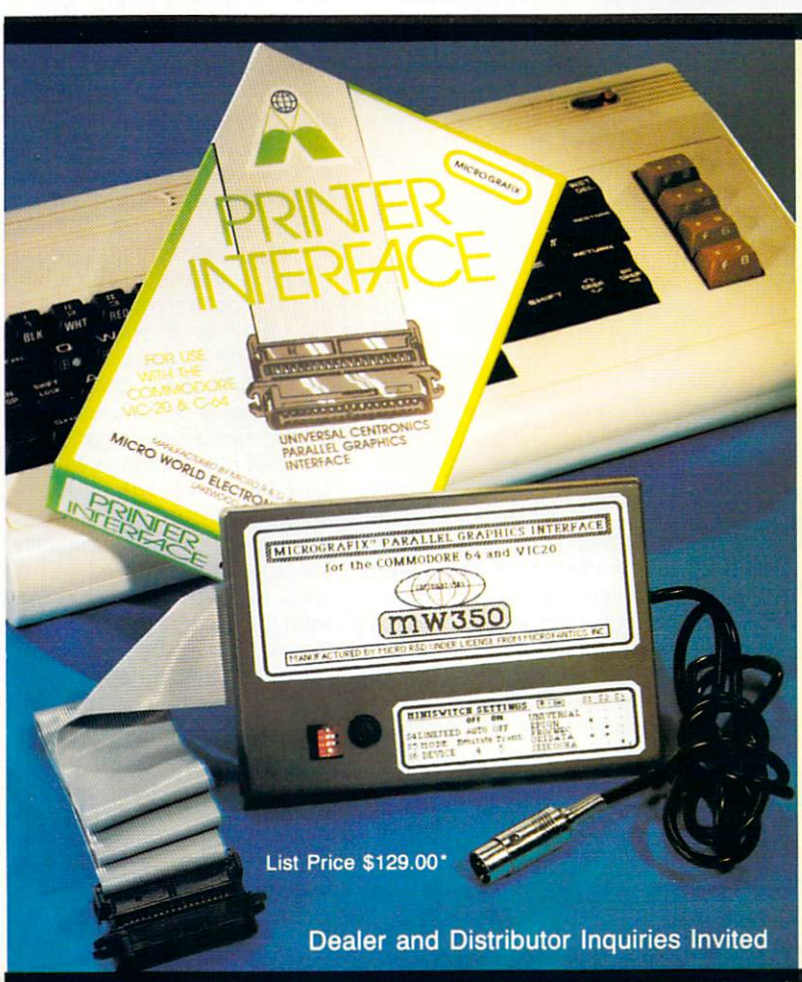
Okidata recently introduced an exciting new color printer that incorporates thermal technology: the Okimate 10. Thermal printers have fallen into disrepute in recent years. Users have shunned them because the special paper required for these low-cost printers was hard to find, generally more costly and often produced an undesirable print quality. Okidata seems to have overcome these drawbacks. Their new printer will allow the use of any type of paper (even transparencies), since the thermal part of the Oki 10's technology is confined to the print head and ribbon. The printer is somewhat slower than commercial printers of this type, but anyone who routinely prints high-resolution graphic pictures is used to seeing even superfast 120 cps printers crawl along at a much slower speed. The excellent quality of the color pictures should more than compensate for the slower print speed.

The Plug-n-Print interface for the Okimate 10 comes with a screen dump and utility software. You can immediately print pictures made with a variety of Commodore-compatible touch tablets and other graphics aids.

Also contained on the same disk are a complete set of directions for you to print out and a utility that allows you to use the Oki 10's capabilities in your own programs. The printer comes with its own special thermal ribbons, one color and one black. The ribbons are not continuous and you can expect to print out only eight to ten color pictures, 13 at most (depending on your graphics program), before you head out to purchase another ribbon, listing for $6.95.

This puts the cost of Oki 10 prints in the same price range as developing color prints from your camera or buying instant print film. The black ribbon, intended for word processing, lasts a bit longer. It will give you (roughly) 80 pages or so before it bites the dust. Most of the potential users I queried found this mortality rate acceptable, particularly computer artists and graphic whizzes. They felt the high quality of the Oki 10's output, crisp, clear color with hundreds of possible shades and excellent black and white business quality dot matrix characters, would more than make up for the necessity of frequent ribbon replacement.

Cardco Inc. has a new line of letter quality, daisy wheel impact printers (plug-com-



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patible with the 64), the LQ-1 and the LQ-3. The printers are OEMed (original equipment manufactured) by the company that makes the popular Silver Reed, but with the interfaces built in by Cardco. The LQ-3's print speed is 13 cps (characters per second), not bad when compared to the seven cps of some other popular brands. For people who must have typewriter style print, the LQ-3 provides bold, underlining, superscript and subscript. It is always nice to buy a product, take it home and be able to use it immediately without having to struggle with cables or interfaces.

The number of accessories for your Commodore computer is growing, and ranges from joysticks to IEEE interfaces. I have had the opportunity to use many of the items and I think that the overall quality of Commodore add-ons has improved tremendously over the last year or so.

I have examined products such as a light pen from Inkwell with excellent software called *Flexidraw*. Although expensive for a light pen on the 64 ($149.00), it certainly is desirable for anyone wanting superior drawing abilities and the kind of computer-aided design not often offered for $200 computers.

From Suncom, who is noted for its joysticks, comes the Animation Station, a graphics tablet much like the KoalaPad introduced early this year by Koala Technologies. It uses the same technology and, in fact, all Koala software is compatible with Suncom's product. Suncom is producing some interesting software of its own as well, including a program aimed at home decorators. One example: it lets you get an idea of what your living room will look like rearranged—before you move all that heavy furniture around! Interesting features are a small knob on the back that allows zeroing the cursor and a place on the side of the pad to hold the stylus.

Personal Peripherals, producers of the Super Stick joystick, now have a different kind of graphics tool. Called Super Sketch, it sports an arm attached to two potentiometers, rather than the familiar black resistive pad. The easel or board has a row of buttons at the top, one of which controls the clamping of a drawing you might want to trace.

Suncom's Animation Station touch tablet is compatible with Koala software.

Muppet Learning Keys help non-readers use their Commodore 64.

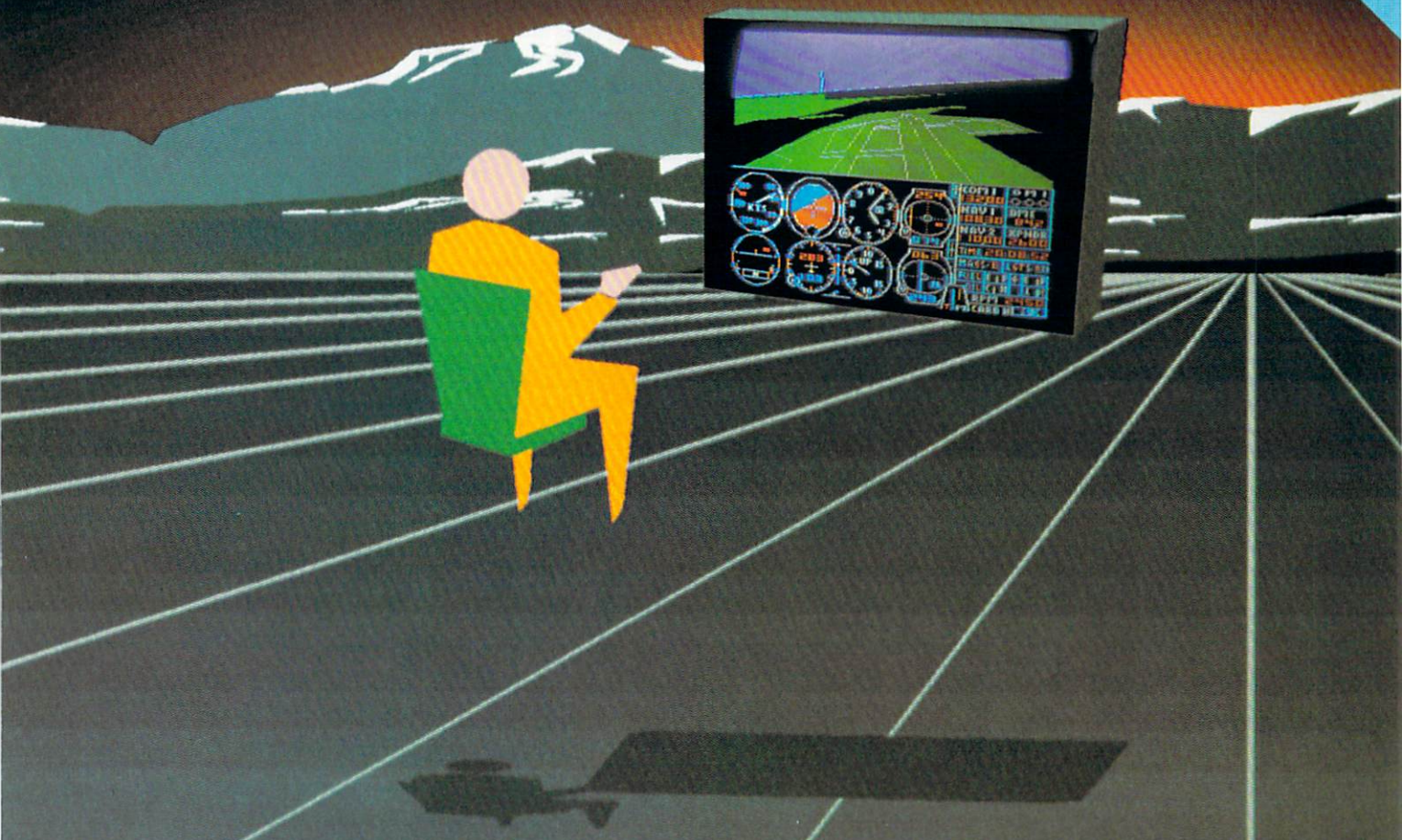
SuperSketch may take some getting used to, because of its differences from Koala-types of tablets that many of us have become accustomed to but its unique features and advanced drawing program may just be worth the effort.

In addition to the third-party hardware being produced, Commodore itself has some new peripherals worth talking about. Commodore's two new disk drives are the 1542 (for the 64, Plus/4 and Commodore 16) and the SF 481 (a parallel drive for the Plus/4 and Commodore 16). The 1542 is cosmetically similar to the 1541, with a lock-down style disk opening, rather than the spring-type door of past models. The mechanical portion of this new drive is not the ALPS drive found in the 1541 and it is said to run much cooler and more efficiently than the older model. Inside the 1542 is a short circuit board and (I expect) a new DOS ROM, fully compatible with existing 64 software. The SF 481 has a parallel connection that plugs into the expansion port of the Plus/4, allowing much faster disk access; good news, especially for schools and businesses who demand fast loading from their machines. The best things about products manufactured by Commodore itself are, first, that you can be sure they're completely compatible and, second, that you don't need additional interfaces.

There is more to be said about Commodore-compatible hardware, but this should at least give you an overview of the most exciting new products.

Flight Simulator II

For the Commodore 64™



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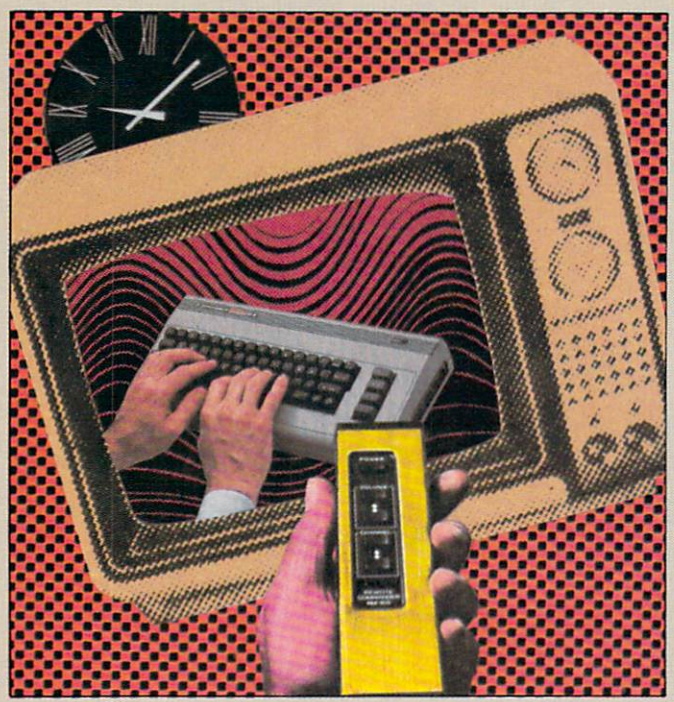
Circle Reader Service No. 8

Commodore 64 Subject of Cable Series

By P. Greg Alland

An independent producer for Manhattan Cable Television initially produced a 28-minute video tape featuring software for the Commodore 64 to visually check the signal over the broadcast lines. The results were so pleasing that a series evolved. Here's how it came about.



Spot Illustrations: Royal Scott

My computer-television career began, strangely enough, through martial arts. We were using the Commodore 64 for script preparation and secured the *PaperClip* word processor from Batteries Included during a martial arts training seminar I conducted in Toronto. (This software package was later featured on the first TV program in the series.)

Later, since the initial signal check experiment was such a success, I came up with the idea of a computer cable television program devoted entirely to consumers. We decided we could provide a new and important source using a format centered around the needs of the average computer user.

Initially the show would be confined to four departments: current programming, new user friendly software, computer user workshops and a question and answer period. With this in mind, I approached people at several computer trade shows in New York City. Almost everyone I spoke with agreed that the idea of a television show devoted to computer users was a targeted marketplace.

I then began lecturing at seminars where I encouraged software publishers and original equipment manufacturers to join this new television concept. The idea seemed sound and we decided to seek to produce the show.

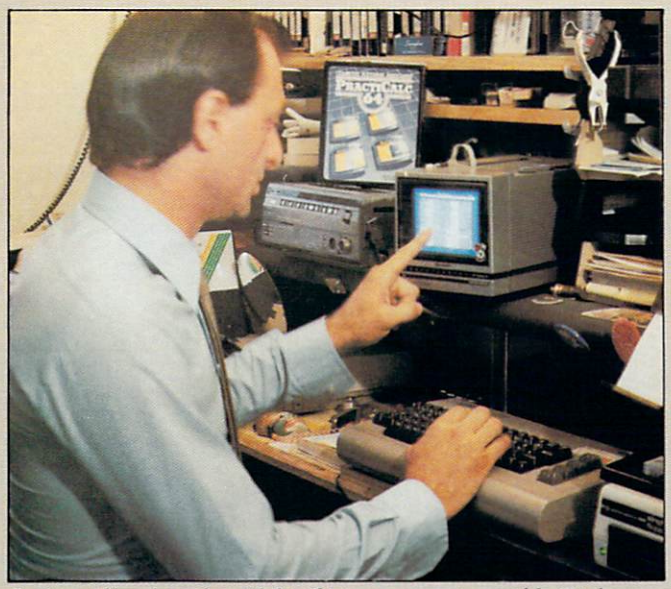
Arranging for initial advertising funds kept us in almost constant deprivation, but I knew survival, not money, was the key to success in the television industry. With that in mind, I begged, borrowed and ultimately produced the first cable computer show devoted to software. Later, I planned and contracted air time for the series.

It wasn't easy. I remember one instance when we presented the demonstration tape to a prospective client. The store owner's son was enthusiastic and kept asking questions. The owner had other thoughts, however. He totally ignored the youngster and we were quickly back banging the pavement looking for advertisers.

I immediately began preparing more sophisticated material, which prompted a response from the largest New York computer chain store, Park Plaza Computer Center. We agreed to air another pilot program and again test the response. Each time the program aired, their phone rang incessantly. It was soon apparent that we could successfully produce more shows with Park Plaza, so we prepared to continue production.

I realized during the December broadcasts for Park Plaza that developing a computer program series made more than a lot of sense to individuals in today's computer society. But the computer had to be the Commodore 64.

I had started with a Commodore 64 and had fallen in love with the high-resolution graphics, sound capabilities and power of this inexpensive home computer. I was doing everything on my 64 that my brother was doing on his $8,000 micro, plus I had color! I often spoke to individuals with 64's who said just getting started was their first and most



P. Greg Alland works with his 64 to create a new cable TV show.

important task. (It was also mine during my earlier research.)

Since that time, many major software publishers have submitted material to our TV program. Park Plaza Computer Center has arranged use of available computer equipment and Libra Laboratories has agreed to help supply guest speakers. We also included material from popular magazines. New versions have been aired and again callers have been inquiring about the show.

I learned not to just let these callers go. I began assisting them with their computers, helped them get started and created quite a following of business and home computer users.

At this point, several new programs have been developed and the series is underway. Audiences range from 14 to 36 year olds, yet I often speak with individuals from each extreme, including one gentlemen who appears to be 90!

Reach and scope for the future of the Program Critic Computer Show includes greater attention to the users of home and business computers. These individuals seem to outnumber programmers, and place a greater emphasis on user friendliness.

New material is constantly being sought for future shows on the Program Critic Computer Show. If you would like to offer some ideas, obtain copies of the show or would like to see the program in your cable television area, send the name, address and telephone number of your cable company and your name and address to: The Program Critic Computer Show, P.O. Box 2632, New York, NY 10009. **C**

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Circle Reader Service No. 9

Disk and DOS Wedge Commands

For the Commodore 64 and VIC 20

By Elizabeth Deal

```
100 REM"S=SAVE"@1:DISK COMMANDS",8
101 :
102 :
103 :
104 :
105 :
106 :
107 REM-------------------------------------------------------------------------
108 REM SUMMARY OF COMMODORE DISK COMMANDS ... ELIZABETH DEAL
109 REM-------------------------------------------------------------------------
110 REM
111 REM *** DISK'S COMMAND CHANNEL (15) UNDERSTANDS
112 REM     (1) ONE LETTER UTILITY COMMANDS:    N I V R C S D
113 REM
114 REM     N  NEW (FORMAT,HEADER) A FLOPPY, USE WITH CARE, USUALLY ONCE
115 REM     I  INITIALIZE, USE OFTEN
116 REM     V  VALIDATE (COLLECT)
117 REM     R  RENAME A FILE
118 REM     C  COPY (IN SINGLE DRIVES MOSTLY USED TO APPEND FILES...
119 REM           USE COPY/ALL TO COPY ACROSS TWO SINGLE DRIVES)
120 REM     S  SCRATCH A FILE
121 REM     D  DUPLICATE (BACKUP) DUAL DRIVES
122 REM
123 REM     (2) TWO-LETTER UTILITY COMMANDS
124 REM
125 REM     UI+ 1541 SPEED C64
126 REM     UI- 1541 SPEED VIC-20
127 REM     UJ  RESET DISK (IT'S SILENT - NO HEAD BUMPING)
128 REM
129 REM
130 REM *** COMMAND CHANNEL ALSO UNDERSTANDS
131 REM     DIRECT ACCESS COMMANDS TO WORK IN CONJUNCTION
132 REM     WITH DATA HANDLING COMMANDS
133 REM     SEE USER'S MANUAL FOR USE AND SYNTAX
134 REM
135 REM  1. RELATIVE ACCESS
136 REM     P  RECORD POSITIONING
137 REM     PRINT#15,"P"CHR$(SECAD)CHR$(REC#.LO)CHR$(REC#.HI)CHR$(BYTEPOS)
138 REM     (RECORD #32769: LO=1, HI=128/RECORD #1027: LO=3, HI=4)
139 REM
140 REM  2. SECTOR/BLOCK READ,WRITE,ALLOCATE,FREE,POINTER,EXECUTE
141 REM     THE 'UX' FORM IS PREFERRED!
142 REM     U1 SAME AS B-R BUT POINTER POINTS AT THE FIRST BYTE IN A SECTOR
143 REM     U2 SAME AS B-W ...DITTO...
144 REM     B-A,B-F,B-P,B-E
145 REM
146 REM  3. RAM/ROM READ,WRITE,EXECUTE DOS OR USER CODE
147 REM     M-R,M-W,M-E
148 REM
149 REM  4. JUMPS TO DOS-ROM CODE IF YOU KNOW WHAT THE ROM CODE DOES...
150 REM     U3 TO U9
151 REM
152 REM-------------------------------------------------------------------------
153 REM
154 REM *** LONG FORM OF COMMON COMMANDS MUST BE USED WITHIN A PROGRAM
155 REM
156 REM
157 REM     WHATEVER IS IN QUOTES CAN BE A CHARACTER STRING
```

(Continued On Page 28)

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Circle Reader Service No. 10

```
158 REM     U$="S0:PROG":PRINT#15,U$ IS A RECOMMENDED FORM
159 REM
160 REM     PRINT#15,"N0:DISKNAME,H2"  = TOTAL WIPEOUT, ALL AREAS=0 IN 4040
161 REM     AND=1 IN 1540/1541, NEW ID=H2
162 REM     PRINT#15,"N0:NEWNAME"      = CLEARS DIRECTORY (ID MUST EXIST)
163 REM     PRINT#15,"I0"
164 REM     PRINT#15,"V0"
165 REM     PRINT#15,"R0:NEWFILENAME=0:OLDFILENAME"
166 REM     PRINT#15,"C0=1" DUAL ONLY, COPIES ALL FILES SLOWLY AND CAREFULLY
167 REM     PRINT#15,"C0:BIGFILE=0:SMALL-A,0:SMALL-B,0:SMALL-C"
168 REM     PRINT#15,"C0:NEWFILE=0:OLDFILE"  SINGLE DRIVE RENAME,COPY-USELESS
169 REM     PRINT#15,"C1:NEWCOPY=0:OLDCOPY"  DUAL DRIVES ONLY
170 REM     PRINT#15,"S0:NOTWANTED"
171 REM     PRINT#15,"D1=0"  DUPLICATES DRIVE 0 ONTO DRIVE 1 - DUAL DRIVES
172 REM     PRINT#15,"P"CHR$(SECAD)CHR$(REC#.LO)CHR$(REC#.HI)CHR$(BYTEPOS)
173 REM
174 REM     10 INPUT#15,E1,E$,E3,E4 IN PROGRAM MODE READS THE ERROR CHANNEL
175 REM     IN ORDER: MESSAGE#,MESSAGE,TRACK#,SECTOR# (LAST 2, IF RELEVANT)
176 REM
177 REM-------------------------------------------------------------------------
178 REM
179 REM *** CORRESPONDING DOS-WEDGE COMMANDS
180 REM
181 REM     SIMPLER TO USE IN DIRECT MODE: QUOTES ARE NOT NEEDED,
182 REM     OPENING CH.15 IS NOT NEEDED, AND THERE IS NO NEED TO
183 REM     WRITE A PROGRAM TO QUERY THE ERROR CHANNEL
184 REM
185 REM    'C-64 WEDGE5.1' IS NOT RELOCATABLE, IT LIVES AT $CC00-CF60
186 REM     CAN BE SAVED FROM SUPERMON64 USING THE GIVEN ADDRESSES
187 REM     IT CAN BE LOADED DIRECTLY: LOAD"DOS5*",8,1 - FOLLOW THIS BY ...
188 REM     NEW THEN SYS52224 TO CLEAN UP THE HOUSE AND ENABLE THE WEDGE
189 REM     IT CAN GET CLOBBERED BY OTHER NONRELOCATABLE PROGRAMS.
190 REM
191 REM     EITHER > (GREATER THAN KEY)OR @ (AT-SIGN KEY) CAN BE USED
192 REM
193 REM     >N0:DISKNAME,H2                                  FORMAT
194 REM     >N0:NEWDISKNAMEONLY                              CLEARS BAM & DIRECTORY
195 REM     >I0                                              INITIALISES BAM,ID
196 REM     >V0                                              VALIDATES
197 REM     >R0:NEWFILENAME=0:OLDFILENAME                    RENAMES A FILE
198 REM     >C0=1                                            DUAL,COPIES ALL FILES
199 REM     >C0:BIGFILE=0:SMALL-A,0:SMALL-B,0:SMALL-C        APPENDS FILE(S)
200 REM     >C0:NEWNAME=0:OLDNAME                            SAME AS RENAME+COPY
201 REM     >C1:NEWCOPY=0:OLDCOPY                            DUAL DRIVES COPY+RENAME
202 REM     >C1:SAMENAME=0:SAMENAME                          DUAL DRIVES COPY
203 REM     >S0:NOTWANTED                                    SCRATCHES,DELETES FILE
204 REM     >D1=0                                            DUAL - BACKUP,DUPLICATE
205 REM     >UJ                                              SILENT RESET 154X
206 REM
207 REM
208 REM *** DOS WEDGE5.1 ALSO CONTAINS THESE COMMANDS
209 REM
210 REM     >                          INPUTS ERROR CHANNEL (15) MESSAGE
211 REM     >9                         SWITCHES COMMANDS TO DIFFERENT DEVICE
212 REM                               (USE CHANGE PROGRAM TO CHANGE DEVICE#)
213 REM     >Q                         KILLS WEDGE (SYS52224=$CC00 CONNECTS)
214 REM     ↑PRGFILE*                  (UPARROW) LOADS (RELOCATES), AND RUNS
215 REM     /PRGFILE*                  (SLASH)   LOADS (RELOCATES)
216 REM     %PRGFILE*                  (PERCENT) LOADS, NONREL,NO PTR CHANGE
217 REM     ←PRGFILE                   (BACKARROW) SAVES A BASIC PROGRAM
218 REM     ←PRGFILE[V]                SAME+TACKS A LETTER AT THE END
219 REM     >$0                        DIRECTORY ALL FILES
220 REM     >$0:FIL*                   THOSE BEGINNING WITH FIL
221 REM     >$0:?FIL*                  WILD CARD ON ? CHARACTER
222 REM     >$0:*=P                    PRG FILES,S=SEQ,R=REL,U=USR
223 REM     >$0:ZSZMZ                  BLOCKS FREE ETC (TYPE ANYTHING AFTER:)
224 REM
225 REM NOTE THAT THERE IS NO DISPLAY DIRECTORY COMMAND
226 REM IN BASIC. IT CAN ONLY BE LOADED IN OR READ IN A PROGRAM
227 REM SYNTAX AS ABOVE CAN BE USED TO SELECT FILES.
228 REM-------------------------------------------------------------------------
```

C

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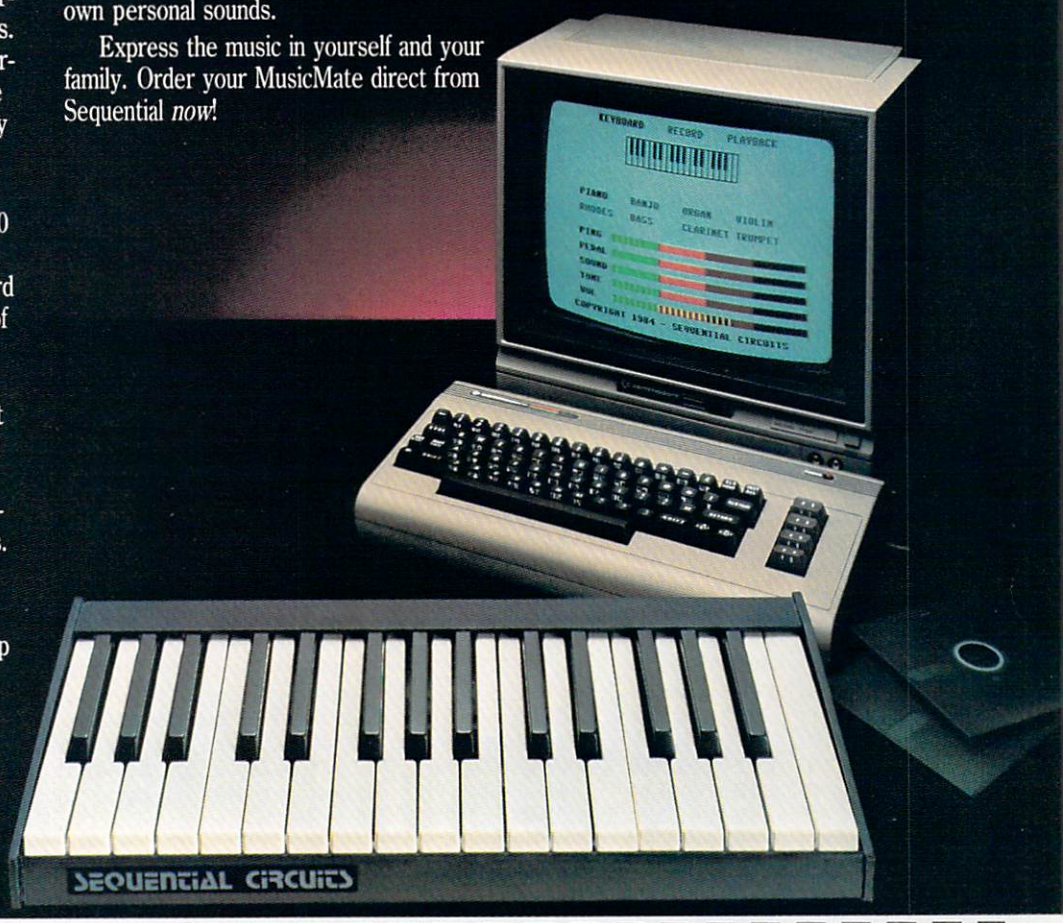

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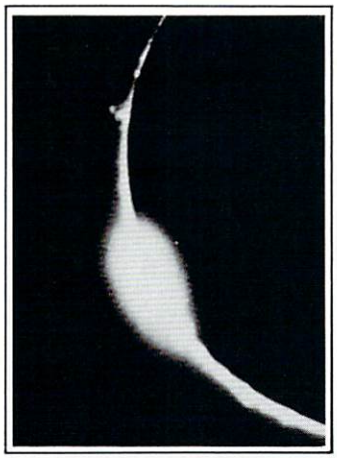
Commodore Plus/4 and Commodore 16 Memory Map

Label	Hex Addr.	Decimal Loc.	Description
PDIR	$0000	0	6510 on-chip data-direction register
PORT	$0001	1	6510 on-chip 8-bit Input/Output register
SRCHTK	$0002	2	Token 'search' looks for (run-time stack)
ZPVEC1	$0003-0004	3-4	Temp (renumber)
ZPVEC2	$0005-0006	5-6	Temp (renumber)
CHARAC	$0007	7	Search character
ENDCHR	$0008	8	Flag: scan for quote at end of string
TRMPOS	$0009	9	Screen column from last TAB
VERCK	$000A	10	Flag: 0 = load 1 = verify
COUNT	$000B	11	Input buffer pointer / No. of subscripts
DIMFLG	$000C	12	Flag: Default Array DIMension
VALTYP	$000D	13	Data type: $ff = string $00 = numeric
INTFLG	$000E	14	Data type: $80 = integer $00 = floating
DORES	$000F	15	Flag: DATA scan/LIST quote/garbage coll
SUBFLG	$0010	16	Flag: subscript ref / user function call
INPFLG	$0011	17	Flag: $00 = INPUT $40 = GET $98 = READ
TANSGN	$0012	18	Flag: TAN sign / comparison result
CHANNL	$0013	19	Flag: INPUT prompt
LINNUM	$0014-0015	20-21	Temp: integer value
TEMPPT	$0016	22	Pointer: temporary string stack
LASTPT	$0017-0018	23-24	Last temp string address
TEMPST	$0019-0021	25-33	Stack for temporary strings
INDEX1	$0022-0023	34-35	Utility pointer area
INDEX2	$0024-0025	36-37	Utility pointer area
RESHO	$0026	38	
RESMOH	$0027	39	
RESMO	$0028	40	
RESLO	$0029	41	
	$002A	42	
TXTTAB	$002B-002C	43-44	Pointer: start of BASIC text
VARTAB	$002D-002E	45-46	Pointer: start of BASIC variables
ARYTAB	$002F-0030	47-48	Pointer: start of BASIC arrays
STREND	$0031-0032	49-50	Pointer: end of BASIC arrays (+1)
FRETOP	$0033-0034	51-52	Pointer: bottom of string storage
FRESPC	$0035-0036	53-54	Utility string pointer
MEMSIZ	$0037-0038	55-56	Pointer: highest address used by BASIC
CURLIN	$0039-003A	57-58	Current BASIC line number
TXTPTR	$003B-003C	59-60	
FNDPNT	$003D-003E	61-62	
DATLIN	$003F-0040	63-64	Current DATA line number
DATPTR	$0041-0042	65-66	Pointer: current DATA item address
INPPTR	$0043-0044	67-68	Vector: INPUT routine
VARNAM	$0045-0046	69-70	Current BASIC variable name
VARPNT	$0047-0048	71-72	Pointer: current BASIC variable data
FORPNT	$0049-004A	73-74	Pointer: index variable for FOR/NEXT
OPPTR	$004B-004C	75-76	
OPMASK	$004D	77	
DEFPNT	$004E-004F	78-79	
DSCPNT	$0050-0051	80-81	
	$0052	82	
HELPER	$0053	83	
JMPER	$0054	84	
SIZE	$0055	85	
OLDOV	$0056	86	
TEMPF1	$0057	87	

(Continued On Page 32)



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PROMAL is fast.

Commodore 64 Benchmark (Sieve of Eratosthenes)	PROMAL	BASIC	COMAL	FORTH	PASCAL	
Execution Time (secs.)	30	630	490	51	55	
Object Code Size (bytes)	128	255	329	181	415	
Program Load Time (secs.)	3.2	3.8	6.3	11.2	23.5	
Compile Time (secs.)	8.5	—	—	3.9	108	

As the benchmark results in the table show, PROMAL is much faster than any language tested. From 70% to 2000% faster! And it generates the most compact object code. The PROMAL compiler is so fast that it can compile a 100-line source program in 10 seconds or less. And, not only is it fast in compile and run time, it also reduces programming development time.

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- Procedures w/passed arguments
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- Command oriented, w/line editing
- Memory resident
- Allows multiple user programs in memory at once
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- Program abort and pause
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- Prior command recall
- I/O Re-direction to disk or printer
- Batch jobs

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- Full-screen, cursor driven
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- Line insert, delete, search
- String search and replace
- Block copy, move, delete & write to/read from file
- Auto indent, undent support

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- Memory resident
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```
HIGHDS   $0058-0059    88-89
HIGHTR   $005A-005B    90-91
         $005C         92
LOWDS    $005D-005E    93-94
LOWTR    $005F         95
EXPSGN   $0060         96
FACEXP   $0061         97          Floating-point accumulator #1: exponent
FACHO    $0062         98          Floating accum. #1: mantissa
FACMOH   $0063         99
FACMO    $0064         100
FACLO    $0065         101
FACSGN   $0066         102         Floating accum. #1: sign
SGNFLG   $0067         103         Pointer: series evaluation constant
BITS     $0068         104         Floating accum. #1: overflow digit
ARGEXP   $0069         105         Floating-point accumulator #2: exponent
ARGHO    $006A         106         Floating accum. #2: mantissa
ARGMOH   $006B         107
ARGMO    $006C         108
ARGLO    $006D         109
ARGSGN   $006E         110         Floating accum. #2: sign
ARISGN   $006F         111         Sign comparison result: accum. #1 vs #2
FACOV    $0070         112         Floating accum. #1. low-order (rounding)
FBUFPT   $0071-0072    113-114     Pointer: cassette buffer
AUTINC   $0073-0074    115-116     Increment value for auto (0=off)
MVDFLG   $0075         117         Flag if 10K hires allocated
KEYNUM   $0076         118
KEYSIZ   $0077         119
SYNTMP   $0078         120         Used as temp for indirect loads
DSDESC   $0079-007B    121-123     Descriptor for ds$
TOS      $007C-007D    124-125     Top of run time stack
TMPTON   $007E-007F    126-127     Temps used by music (tone & volume)
VOICNO   $0080         128
RUNMOD   $0081         129
POINT    $0082         130
GRAPHM   $0083         131         Current graphic mode
COLSEL   $0084         132         Current color selected
MC1      $0085         133         Multicolor1
FG       $0086         134         Foreground color
SCXMAX   $0087         135         Maximum # of columns
SCYMAX   $0088         136         Maximum # of rows
LTFLAG   $0089         137         Paint-left flag
RTFLAG   $008A         138         Paint-Right flag
STOPNB   $008B         139         Stop paint if not BG (Not same Color)
GRAPNT   $008C-008D    140-141
VTEMP1   $008E         142
VTEMP2   $008F         143


STATUS   $0090         144         Kernal I/O status word:  ST
STKEY    $0091         145         Flag: STOP key / RVS key
SPVERR   $0092         146         Temp
VERFCK   $0093         147         Flag: 0 = load  1 = verify
C3PO     $0094         148         Flag: serial bus - output char buffered
BSOUR    $0095         149         Buffered character for serial bus
XSAV     $0096         150         Temp for basin
LDTND    $0097         151         # of open files / index to file table
DFLTN    $0098         152         Default input device (0)
DFLTO    $0099         153         Default output (CMD) device (3)
MSGFLG   $009A         154         Flag: $80 = direct mode  $00 = program
SAL      $009B         155         Tape pass 1 error log
SAH      $009C         156         Tape pass 2 error log
EAL      $009D         157
EAH      $009E         158
T1       $009F-00A0    159-160     Temp data area
T2       $00A1-00A2    161-162     Temp data area
TIME     $00A3-00A5    163-165     Real-time jiffy clock (approx) 1/60 sec
R2D2     $00A6         166         Serial bus usage
TPBYTE   $00A7         167         Byte to be written/read on/off tape
BSOUR1   $00A8         168         Temp used  by serial routine
```

(Continued on page 34)

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Circle Reader Service No. 13

```
FPVERR   $00A9          169
DCOUNT   $00AA          170
FNLEN    $00AB          171          Length of current file name
LA       $00AC          172          Current logical file number
SA       $00AD          173          Current secondary address
FA       $00AE          174          Current device number
FNADR    $00AF-00B0     175-176      Pointer: current file name
ERRSUM   $00B1          177
STAL     $00B2          178          I/O start address
STAH     $00B3          179
MEMUSS   $00B4-00B5     180-181      Load ram base
TAPEBS   $00B6-00B7     182-183      Base pointer to cassette base
TMP2     $00B8-00B9     184-185
WRBASE   $00BA-00BB     186-187      Pointer to data for tape writes
IMPARM   $00BC-00BD     188-189      Pointer to immediate string for primms
FETPTR   $00BE-00BF     190-191      Pointer to byte to be fetched in bank fetc
SEDSAL   $00C0-00C1     192-193      Temp for scrolling
RVS      $00C2          194          RVS field flag on
INDX     $00C3          195
LSXP     $00C4          196          X position at start
LSTP     $00C5          197
SFDX     $00C6          198          Flag: shift mode for print
CRSW     $00C7          199          Flag: INPUT or GET from keyboard
PNT      $00C8-00C9     200-201      Pointer: current screen line address
PNTR     $00CA          202          Cursor column on current line
QTSW     $00CB          203          Flag: editor in quote mode  $00 = no
SEDT1    $00CC          204          Editor temp use
TBLX     $00CD          205          Current cursor physical line number
DATAX    $00CE          206          Temp data area
INSRT    $00CF          207          Flag: insert mode, >0 = # INSTs
         $00D0-$00D7    208-215      Area for use by speech software
         $00D8-00E8     216-232      Area for use by application software
CIRSEG   $00E9          233          Screen line link table / editor temps
USER     $00EA-00EB     234-235      Screen editor color IP
KEYTAB   $00EC-00ED     236-237      Key scan table indirect
TMPKEY   $00EE          238
NDX      $00EF          239          Index to keyboard queue
STPFLG   $00F0          240          Pause flag
TO       $00F1-00F2     241-242      Monitor ZP storage
CHRPTR   $00F3          243
BUFEND   $00F4          244
CHKSUM   $00F5          245          Temp for checksum calculation
LENGTH   $00F6          246
PASS     $00F7          247             Which pass we are doing str
TYPE     $00F8          248             Type of block
USEKDY   $00F9          249             (B.7=1)=> for wr,(B.6=1)=> for rd
XSTOP    $00FA          250             Save xreg for quick stopkey test
CURBNK   $00FB          251             Current bank configuration
XON      $00FC          252             Char to send for a x-on
XOFF     $00FD          253             Char to send for a x-off
SEDT2    $00FE          254             Editor temporary use
LOFBUF   $00FF          255

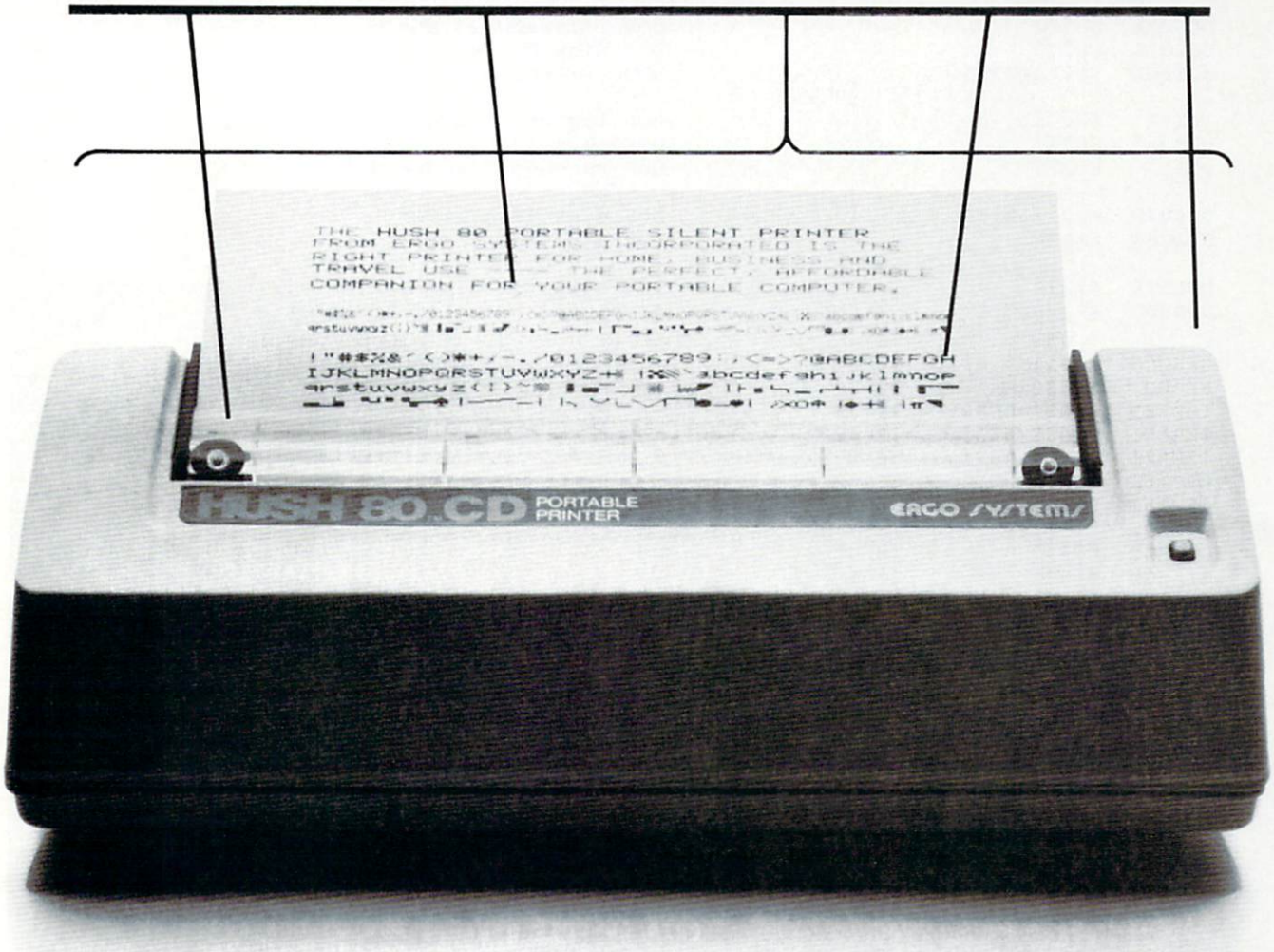

FBUFFR   $0100-$010F    256-271
SAVEA    $0110          272             Temp Locations for
SAVEY    $0111          273             ...for Save and
SAVEX    $0112          274             ...Restore
COLKEY   $0113-0122     275-289         Color/luminance table in RAM
SYSSTK   $0124-01FF     291-511         System stack

BUF      $0200-0258     512-600         Basic/monitor buffer
OLDLIN   $0259-025A     601-602         Basic storage
OLDTXT   $025B-025C     603-604         Basic storage

         $025D-02AC     605-684         BASIC/DOS INTERFACE AREA
XCNT     $025D                          DOS loop counter
FNBUFR   $025E-026D                     Area for filename
DOSFIL   $026E                          DOS filename 1 length
```

(Continued on page 36)

BIG ON FEATURES.



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```
DOSDS1   $026F                          DOS disk drive 1
DOSF1A   $0270-0271                     DOS filename 1 addr

DOSF2L   $0272                          DOS filename 2 length
DOSDS2   $0273                          DOS disk drive 2
DOSF2A   $0274-0275                     DOOS filename 2 addr

DOSLA    $0276                          DOS logical address
DOSFA    $0277                          DOS phys addr
DOSSA    $0278                          DOS secondary address

DOSDID   $0279-027A                     DOS disk identifier
DIDCHK   $027B                          DOS DID flag

DOSSTR   $027C                          DOS output string buffer
DOSSPC   $027D-02AC                     Area used to build DOS string

                                        Graphics Variables
XPOS     $02AD-02AE     685-686         Current x position
YPOS     $02AF-02B0     687-688         Current y position
XDEST    $02B1-02B2     689-690         X coordinate destination
YDEST    $02B3-02B4     691-692         Y coordinate destination
XABS     $02B5-02B6     693-694
YABS     $02B7-02B8     695-696
XSGN     $02B9-02BA     697-698
YSGN     $02BB-02BC     699-700
FCT1     $02BD-02BE     701-702
FCT2     $02BF-02C0     703-704
ERRVAL   $02C1-02C2     705-706
LESSER   $02C3          707
GREATR   $02C4          708

ANGSGN   $02C5          709             Sign of angle
SINVAL   $02C6-02C7     710-711         Sine of value of angle
COSVAL   $02C8-02C9     712-713         Cosine of value of angle
ANGCNT   $02CA-02CB     714-715         Temps for angle distance routines

                                        Start of multiply defined area #1
         $02CC          716             Placeholder
BNR      $02CD          717             Pointer to begin no.
ENR      $02CE          718             Pointer to end no.
DOLR     $02CF          719             Dollar flag
FLAG     $02D0          720             Comma flag
SWE      $02D1          721             Counter
USGN     $02D2          722             Sign exponent
UEXP     $02D3          723             Pointer to exponent
VN       $02D4          724             # of digits before decimal point
CHSN     $02D5          725             Justify flag
VF       $02D6          726             # of pos before decimal point (field)
NF       $02D7          727             # of pos after decimal point (field)
POSP     $02D8          728             +/- flag (field)
FESP     $02D9          729             Exponent flag (field)
ETOF     $02DA          730             Switch
CFORM    $02DB          731             Char counter (field)
SNO      $02DC          732             Sign no.
BLFD     $02DD          733             Blank/star flag
BEGFD    $02DE          734             Pointer to beginning of field
LFOR     $02DF          735             Length of format
ENDFD    $02E0          736             Pointer to end of field

XCENTR   $02CC-02CD     716-717
YCENTR   $02CE-02CF     718-719
XDIST1   $02D0-02D1     720-721
YDIST1   $02D2-02D3     722-723
XDIST2   $02D4-02D5     724-725
YDIST2   $02D6-02D7     726-727
         $02D8-02D9     728-729         Placeholder

COLCNT   $02DA          730             Characters column counter
```

```
ROWCNT  $02DB       731         Characters row counter
STRCNT  $02DC       732

                                Start of multiply defined area #2
XCORD1  $02CC-02CD  716-717
YCORD1  $02CE-02CF  718-719
BOXANG  $02D0-02D1  720-721     Rotation angle
XCOUNT  $02D2-02D3  722-723
YCOUNT  $02D4-02D5  724-725
BXLENG  $02D6-02D7  726-727     Length of a side
XCORD2  $02D8-02D9  728-729
YCORD2  $02DA-02DB  730-731

XCIRCL  $02CC-02CD  716-717     Circle center, x coordinate
YCIRCL  $02CE-02CF  718-719     Circle center, y coordinate
XRADUS  $02D0-02D1  720-721     X radius
YRADUS  $02D2-02D3  722-723     Y radius
ROTANG  $02D4-02D5  724-725     Rotation angle
ANGBEG  $02D8-02D9  728-729     Arc angle start
ANGEND  $02DA-02DB  730-731     Arc angle end
XRCOS   $02DC-02DD  732-733     X radius * cos (rotation angle)
YRSIN   $02DE-02DF  734-735     Y radius * sin (rotation angle)
XRSIN   $02E0-02E1  736-737     X radius * sin (rotation angle)
YRCOS   $02E2-02E3  738-739     Y radius * cos (rotation angle)

                                Start of multiply defined area #3
        $02CC       716         Placeholder
KEYLEN  $02CD       717
KEYNXT  $02CE       718
STRSZ   $02CF       719         String length
GETTYP  $02D0       720         Replace string mode
STRPTR  $02D1       721         String position counter
OLDBYT  $02D2       722         Old bit map byte
NEWBYT  $02D3       723         New string or bit map byte
        $02D4       724         Placeholder
XSIZE   $02D5-02D6  725-726     Shape column length
YSIZE   $02D7-02D8  727-728     Shape row length
XSAVE   $02D9-02DA  729-730     Temp for column length
STRADR  $02DB-02DC  731-732     Save shape string descriptor
BITIDX  $02DD       733         Bit index into byte
SAVSIZ  $02DE-02E1  734-737     Temporary work locations

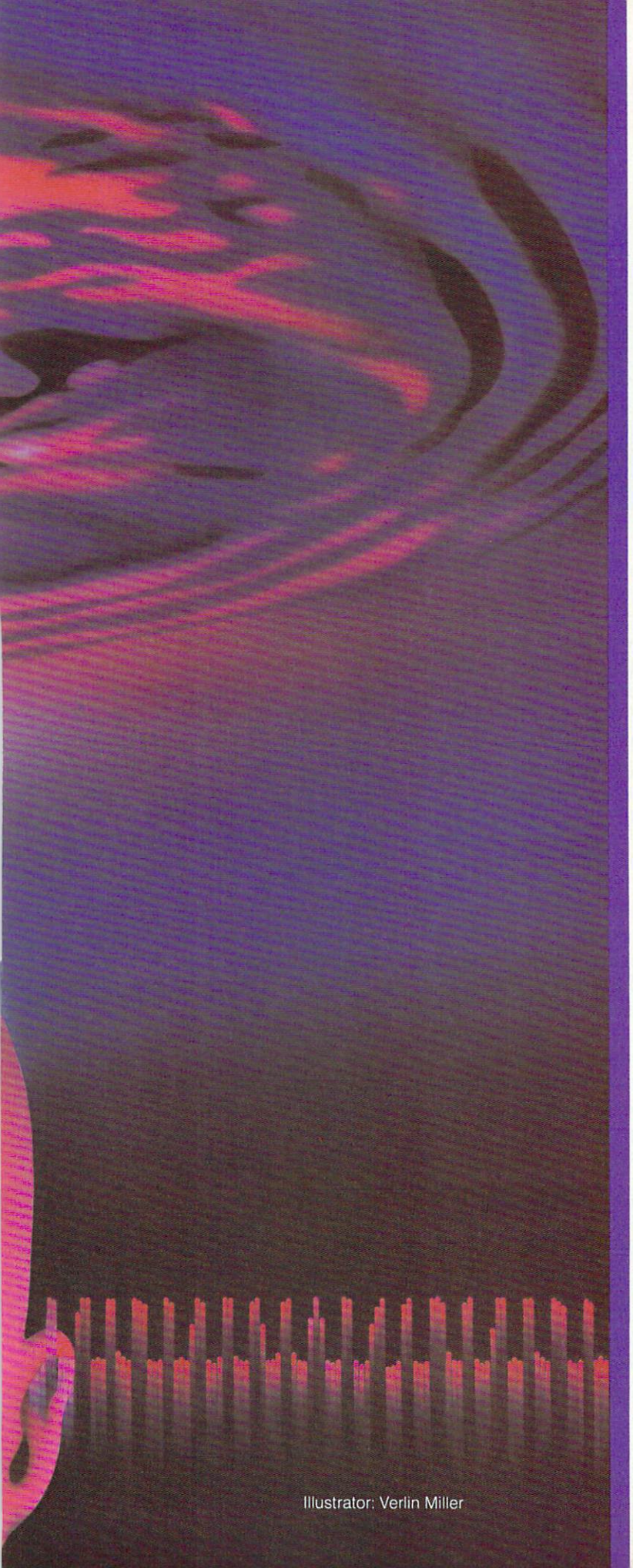
CHRPAG  $02E4       740         High byte addr of char ROM for char cmd
BITCNT  $02E5       741         Temp for gshape
SCALEM  $02E6       742         Scale mode flag
WIDTH   $02E7       743         Double width flag
FILFLG  $02E8       744         Box fill flag
BITMSK  $02E9       745         Temp for bit mask
NUMCNT  $02EA       746
TRCFLG  $02EB       747         Flags trace mode

T3      $02EC       748
T4      $02ED-02EE  749-750
VTEMP3  $02EF       751         Graphic temp storage
VTEMP4  $02F0       752
VTEMP5  $02F1       753

ADRAY1  $02F2-02F3  754-755     Ptr to routine: convert float to intege
ADRAY2  $02F4-02F5  756-757     Ptr to routine: convert integer to floa


BNKVEC  $02FE-02FF  766-767     Vector for function cartridge users
IERROR  $0300-0301  768-769     Indirect Error (Output Error in .X)
IMAIN   $0302-0303  770-771     Indirect Main (System Direct Loop)
ICRNCH  $0304-0305  772-773     Indirect Crunch (Tokenization Routine)
IQPLOP  $0306-0307  774-775     Indirect List (Char List)
IGONE   $0308-0309  776-777     Indirect Gone (Character Dispatch)
IEVAL   $030A-030B  778-779     Indirect Eval (Symbol Evaluation)
IESCLK  $030C-030D  780-781     Escape token crunch
```

(Continued On Page 108)



Illustrator: Verlin Miller

Physics of Sound:

How Computers Make Music

By Christopher U. Light

Computers can do anything . . . well almost anything. They can call out the items you've bought at a grocery store, add up and tell the next person in line your total and announce in a loud voice that your check's no good. They can animate TV commercials and display products you'd swear were the real thing. And they can make music. In fact, they're really quite good—almost virtuosos in their own way.

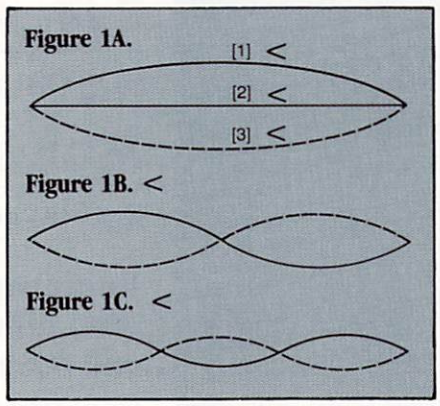
You've probably heard a lot of computer music, but you also probably didn't realize that it was actually being performed by a computer because, in addition to discovering new sounds, one major goal of music programmers has been to write programs that imitate conventional instruments, partly to avoid the cost of an orchestra, partly to satisfy the composer's desire for full control over his music and partly just to show that it can be done. Much of this computer music is used as an accompaniment for something else, especially as background music in the movies or television, rather than in concert.

The computer is ideal for performing music mechanically because it operates with an internal clock anyway and that clock can be used to time musical events far more precisely than any human could. And there's absolutely no reason at all why the music has to sound like computer music. Whenever you hear computer music that goes 'Plink . . . Plunk . . . Long Wait . . . Eeeeeeeee . . . An Even Longer Wait,' that's because the programmer/composer likes it that way. The computer itself isn't that limited and can do some really passable jazz, rock, pop or even classical music.

In order for a computer to make music, it's necessary to develop a model of what music is so that as much as possible of the entire musical experience can be condensed and saved as a set of numbers that can be stored in the computer's memory. This model has already been done for you and is incorporated in a chip built into the Commodore 64, so you don't have to design your own, but an understanding of the basic music model is essential if you want to get the most out of it. When you use this SID chip (short for Sound Interface Device) to make music, you can write BASIC programs to control it as is explained briefly in the *Commodore 64 Programmer's Reference Guide.* But it's much, much easier to buy a software package that does the work for you and lets you spend your time on the music.

These music editors are the equivalent of word processors and are relied on extensively by both amateur and professional computer musicians. However, even though music editors are so useful that it's almost unthinkable not to use one, you still need to understand the basic model behind the SID chip to realize its full potential. And its potential is amazing.

When you examine all the controls it has, you realize that there are more than four trillion different combinations of settings for *each* note. Some of these combinations may not sound appreciably different from others and some may even sound horrible, but the number of useful ones is still so large that you really do need an understanding of the way computers create music to help you pick those that will produce music you're happy with.



Waveforms

Imagine a string stretched between two pegs. If the string is pulled sideways as in Figure 1a and let go, it will vibrate from side to side, slowing down with each vibration until it finally stops. As it moves, it will push air toward any ear that's nearby and this air pressure will be perceived as sound. Actually, since the string is very thin, it can move so little air that you probably won't hear anything, but if the pegs are fastened to a box made of thin wood (as in a guitar or violin), the string will move the wood and the wood will move enough air to make a sound.

In Figure 1a, when the string is let go and first moves from its initial position [1], the spring effect caused by stretching it sideways causes it to move faster and faster until it reaches the center [2]. Momentum keeps it moving past the center to position [3], but the spring action is now in the opposite direction and it slows down. When the string has gone as far as it can, the spring tension on it brings it back through the middle again and to the other side almost, but not quite, to the initial position. Because the string is moving away from the ear as it goes back, it pulls air away from the ear, which reduces the pressure.

Graphing these changes in air pressure on the eardrum results in the sine wave of Figure 2 (so called because its equation uses the sine function studied in high school trigonometry), with numbers keyed to those in Figure 1a. Starting with a stationary string at position [1], the pressure increases as the string moves toward the center [2] and remains positive but decreases as the string goes to its limit of travel on the other side at [3]. Here it stops momentarily and the pressure is again zero. Then the string is pulled backwards and the pressure becomes negative as the air is pulled away first at an increasing rate and after the string has again passed the center [2] the second time at a decreasing rate until it reaches zero again when the string stops momentarily at [1] once more. Then the cycle starts over again and the string continues to vibrate back and forth producing sound until its energy is dissipated.

The speed at which the string vibrates depends on its length and on how tightly stretched it is. This speed can vary from a few times a second to many thousands of times. If the vibration rate is be-

Music Programming Tips

By Christopher U. Light

What would the great composers of the past have thought of computer music? Would they have enthusiastically composed for the new technology or would they have disdained it as a poor imitation of real music? Probably their reactions would have been mixed. Certainly they would have been delighted to use the computer's score-writing capabilities, if only to save the price of a copiest. And since the goal of composition is the search for new sounds and patterns of sound, they could not have rejected the validity of electronic music, although they might have covered their ears at some of the sounds computers produce.

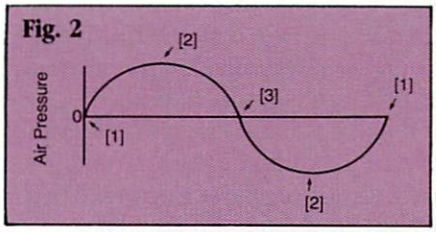
However, the use of a computer as a sequencer to actually perform music would definitely have been as controversial one, two and three centuries ago as it is today. Handel, who did compose for mechanical instruments

tween approximately 50 times a second and 20,000 times a second, the human ear will be able to detect the changes in air pressure as sound. When the string is shortened, it will vibrate faster and will produce a tone of a higher pitch. When it's lengthened, the vibration rate will be slower and the pitch will be lower. When graphed as sine waves as in Figure 2, the higher pitch will appear scrunched up, while the lower pitch will appear stretched out. If the pitch is kept the same, but the loudness is increased, this will be shown on the graph as a higher peak and lower valley at both positions [2]. It would be the opposite for reduced volume.

The sine wave tone produced by a string vibrating as in Figure 1a is the simplest tone possible because it consists of a single frequency and nothing else. If the string is vibrating 264 times a second, you will hear middle C, but that's all. If it vibrates 440 times a second, you will hear above C and so on. The sine wave produces the purest tone that exists, but, because it is so simple, it's not very exciting to musicians. If you'd like to hear something close to a pure sine wave, take a guitar or other stringed instrument and pull a string sideways exactly at its center and let it go gently. You may or may not make a single sine wave, but in any case it will sound somewhat dull. Now pluck the same string sharply with your fingernail near one of its ends, perhaps about 15 percent of the total length. You will hear the same note, but this one will sound much richer, fuller and more exciting.

What Pythagoras discovered so many years ago is that, depending

Fig. 2



on how and where it is plucked or struck, the string actually puts out many more notes than the basic one determined by its length and that the mathematical relationship between the frequencies of these notes is (usually) pleasing to the ear. Figures 1b and 1c illustrate what happens. Within its basic vibration, the two halves of the string may also vibrate independently, each emitting the same note since they're of equal length. Because each of the two parts is exactly half of the original string, the frequency of this new note, which is known as the second harmonic (or second partial or first overtone), is exactly twice that of the base note, which is the fundamental or first harmonic. If the fundamental is middle C and has a frequency of 264 cycles per second, its second harmonic will vibrate 528 times a second. An experienced musician will say that this note is also C, but an octave higher.

In addition to vibrating over its full length and simultaneously over each half, each one-third of the string may also vibrate independently, producing a note whose frequency is three times the fundamental or 792 times a second (Figure 1c). This note would be identified by our musician as G. Right along with this, the string may vibrate as if it were divided into quarters and fifths and sixths, and on up, producing notes with frequencies of 1,056 cycles per second, 1,320 cycles per second, 1,584 cycles per second, and so on. If heard separately, these would be the notes of C, two octaves above middle C, then F, and E, and continues up the scale. And in fact, this simple vibrating string may be simultaneously producing all of the twelve notes that we use in our musical system, although they will be in higher octaves than the fundamental. This is no accident. In fact, our system of music was created by the ancient Greeks based on their discovery of the natural harmonics present in a simple vibrating string.

Each harmonic is generally quieter than the preceding one and the higher ones generally fade out before the lower ones as the string slows down. In fact, many more than the first twelve harmonics may be produced, but they are not used in our note system, probably because they are too faint to be heard most of the time. This use of a note system based on these natural harmonics results in harmonies that we refer to as consonant or dissonant—those that work well together and those that fight each other. If you have a piano handy, listen to two C's played an octave apart. The two notes sound

("Pieces for a Musical Clock"), would surely have realized that the computer is the ultimate music box. J. S. Bach, on the other hand, was as well known as a performer as he was a composer and could sit before a massive cathedral organ and improvise on it as skillfully as any of today's jazz musicians can improvise on a piano. He would probably have said, "Who needs it?" The jazz performer might echo, "It has no soul." And that is the essence of the problem faced by many computer musicians. The machine has no soul. It's all in the head.

If a musician can play well enough so that he can enter the notes through an interfaced keyboard, he can also play a piano or an organ, where he can use the rhythm and feeling in his body to shape his notes. His need for the computer may be only for its different sounds and, perhaps, scorewriting. But the computer can be a great aid for those who just don't have the motor skills to perform on conventional instruments—for those who have ten thumbs, all opposed. In this case, however, the performer/programmer then has to devise ways to put emotion and feeling into notes that initially exist only as lines of

as if they go together because the lower one contains a substantial amount of the higher frequency.

Try C and G on the piano, an interval which in the double counting of musicians is known as a fifth (CDEFG) and then try C and D (a musical second). The first is harmonious, the second harsh. This is because G is the third harmonic of C and is present in large quantities when C is played, while D is the ninth harmonic and is present in C in very small quantities. The wonderful richness the ear hears from a piano as compared with a simple sine wave of the same frequency comes from this mixture of many notes caused by the complex vibration of the string. Guitars sound different from pianos in part because plucking a short string produces harmonics with different volumes (some of which may be zero) than hitting a long string with a felt-covered hammer.

Wind instruments also put out the same harmonics, but, because these harmonics have different volume patterns, these instruments sound very different from string instruments even when playing the same fundamental note. The buzz of a brass instrument, for example, comes from strong upper (i.e., dissonant) harmonics, while the sweetness of a silver flute is the result of very weak harmonics beyond the fundamental. Drums and other percussion instruments on the other hand do not produce these musical harmonics and are not usually tuned to the other instruments they accompany. The characteristic sound of an instrument, produced in part by the pattern of its harmonics, is known as its timbre.

It is very easy to create a sine wave electronically either with analog circuits that control an oscillator directly, with variations in voltage, or digitally using numbers taken from a graph like Figure 2 and stored in a computer's memory. In the latter case, the numbers are used to control the voltage that actually operates the oscillator. The device that translates numbers into voltages is known as a DAC (digital to analog converter).

It would be simple to create a set of harmonic patterns characteristic of any type of instrument by using one oscillator for each harmonic. Each oscillator would then emit a pure note of the appropriate frequency at the volume which, when combined with the others, would produce a sound like, say, a trumpet or piano. The problem is that this would require a prohibitively large number of oscillators for each note, perhaps as many as 16 or more. Three-part harmony with this method might require 48, which is simply beyond the capability of most personal computers. The Commodore 64 has three oscillators and even professional equipment rarely offers more than 16.

The initial approach to waveform control came two decades ago with the invention of the Moog synthesizer, the model for all other electronic instruments until the computer revolution of the 1980's. This type of synthesizer puts out a complex wave and then uses filters to remove unwanted

computer code and which he won't even be able to listen to until he's finished a section of the music. Not only is improvisation out, but you can't even tap your foot to lines of computer code.

Here are some hints that may help beginners get the feel for computer-generated music.

1. Creating the instruments. Listen, listen, listen to all the music you can, but that's not enough. A skilled keyboard performer can use sustain pedals, trills and other devices to fill out music that would sound very thin if he just played the written notes. Try out as many instruments as you can, even if you can't properly play any of them.

Sit down at an organ console and think about the envelope needed to duplicate its sound. When you press a key and realize that the sound starts as soon as the key is pressed and stops only when it is let go, say to yourself: fast attack, long sustain and fast release. When you pluck a guitar and hear the sound begin fading away immediately, you'll think: attack and release only or perhaps attack and decay only, but definitely no period of sustained sound. You'll discover that the

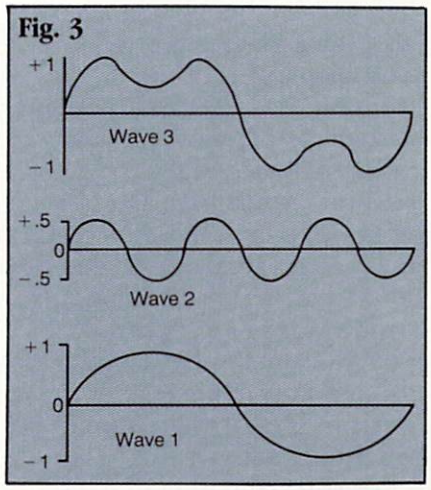
parts. Since these filters remove large bands of harmonics and since they can't put back what wasn't there in the first place, their sound is at best an approximation of conventional instruments.

Additive Synthesis

Instead of the subtractive synthesis used by these analog synthesizers, digital techniques have made it possible to pick the desired harmonics and add them together to produce a single complex wave that is perceived by the listener as if it were a mixture of simple sine waves.

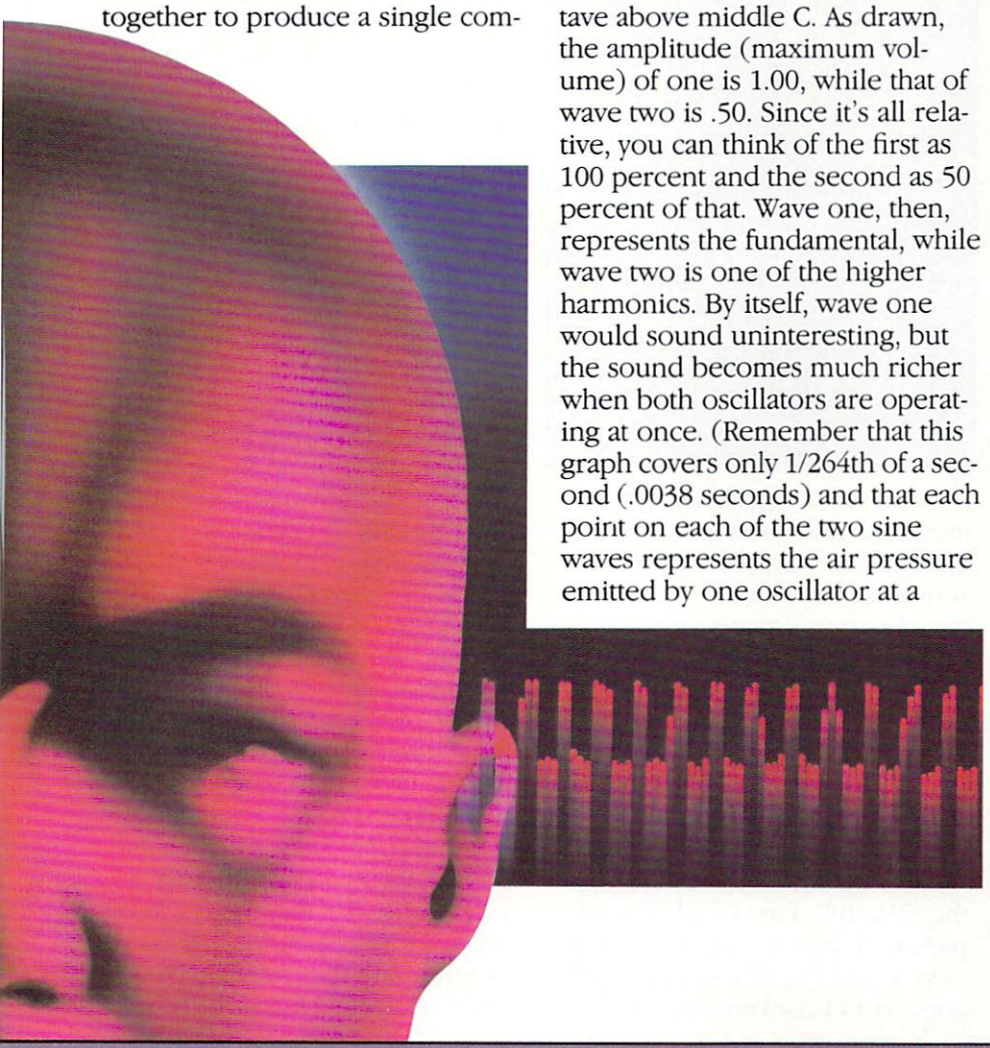
To see how this works, look at Figure 3. At the bottom you'll see two sine waves representing the output of two separate oscillators. The lower of these waves, labeled "1", vibrates, let us say, 264 times a second, which is the musicians' middle C. Wave two vibrates three times as rapidly, 792 times a second, which is the note G in the octave above middle C. As drawn, the amplitude (maximum volume) of one is 1.00, while that of wave two is .50. Since it's all relative, you can think of the first as 100 percent and the second as 50 percent of that. Wave one, then, represents the fundamental, while wave two is one of the higher harmonics. By itself, wave one would sound uninteresting, but the sound becomes much richer when both oscillators are operating at once. (Remember that this graph covers only 1/264th of a second (.0038 seconds) and that each point on each of the two sine waves represents the air pressure emitted by one oscillator at a given instant of time within that fraction of a second.)

Suppose we have only one oscillator instead of two. Looking closely at the bottom two graphs



of Figure 3 again, we might wonder whether or not the actual air pressure that reaches the ear might be the sum of the pressure from the two oscillators. This is in fact the case and we can simply add up the two waves to produce one wave that will sound identical to the two separate waves, but which can be produced by only one oscillator.

We've done this in wave three, which is simply an adding up of the amplitudes of waves one and two at each and every moment in time for the first 1/264th of a second of the sound, which is one complete cycle of wave one and three cycles of wave two. Wave three looks a bit like a sine wave, but with humps in it. Because its frequency is exactly the same as that of wave one, a listener would identify it as the same note, but



higher pitched notes fade faster than the lower ones and require a shorter decay or release period.

Try folk instruments, even a washboard or steel drum. Forget the violin. Unless you've studied it, you won't be able to make a satisfactory sound with the bow and in any case, you'll have an awful time trying to duplicate it with a computer. When a bow is dragged across a vibrating string, it catches the string and lets it go many times a second and effectively starts the note over again each time, something that an ADSR envelope can't capture.

2. Choosing the music. Accept the limitations of your system and use it only for music that sounds good with it. You know that you can't do Beethoven's Ninth Symphony (but then neither can those $50,000 systems used for Hollywood movies), but you might think that, because the SID chip has three voices, a Bach trio sonata would be just fine. Try a few measures. It might be perfect. But if the music doesn't sound right, drop it and go to something else. Even music composed for a traditional instrument that's had five hundred years of development may not work out on another

agree that it is somehow fuller and more interesting. A trained musician with perfect pitch, on the other hand, would hear both C and G, the two notes that went into it, even though neither one was being played directly.

Adding together sine waves from higher harmonics, perhaps as many as 25, allows the computer to imitate really complex musical sounds such as a trumpet or xylophone. Some combinations create waves that are too complex for a single oscillator at the speeds needed for music, but up to a point this method of additive synthesis makes it possible for a computer to produce some amazingly rich, musical tones.

The SID chip built into the Commodore 64 has four waveforms programmed into ROM and one of these can be varied by the user within certain limits. These waves are the sawtooth, which can simulate strings, the triangle, which produces hollow tones reminiscent of certain wind instruments, the pulse, whose sound is variable under user control and the noise wave, which gives a percussive effect.

These are common waves for computer music because they are mathematically well defined. The sawtooth wave results from adding up the sine waves created by all of the harmonics, but weighting each by the reciprocal of its harmonic number. The fundamental, thus, is weighted as 1/1, or 100 percent. Harmonic number two, which is the same note an octave above, is added in at ½ or 50 percent strength, while a weight of only ⅓ or 33 percent is used for the third harmonic, etc. You can see this in Figure 4a, which graphs the percent of each of the first 24 harmonics used according to the formula for a sawtooth wave. The waveform that comes from adding up this harmonic series is shown in Figure 4b.

Figure 4A

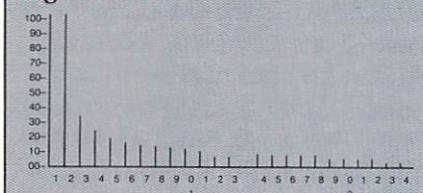
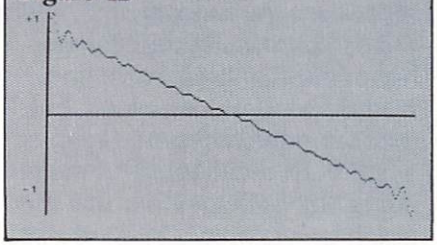


Figure 4B



Additive synthesis can also be used to create a triangle wave. This waveform gets its hollow sound because the even numbered harmonics are missing. The odd numbered ones are weighted by the square of the reciprocal of the harmonic number. The noise wave consists of randomly scattered dots and cannot be synthesized from a set of harmonics.

In a couple of ways, the pulse wave is the most interesting one in the SID chip. First of all, it's completely electronic and represents a new sound that doesn't attempt to copy that of conventional instruments. It's not directly the result of adding together the simple sine waves of the natural harmonics (although it can be approximated that way), but instead comes from switching circuitry that is either on or off. Because this circuitry is easy to design and manufacture, the pulse wave is very common in synthesized music, but the SID chip takes a step that is less common—the user can select the pulse width and thus achieve a fair amount of waveform control. Twelve bits are devoted to pulse width control, so 4,096 different waveforms are possible.

Envelopes

Different waveforms can go only so far in simulating conventional instruments or creating new sounds. The difference between a harpsichord and a piano is not primarily in the vibrating strings, but in the way they are set in motion. A harpsichord string is plucked with a quill. A piano string is struck with a felt-covered hammer (and a piano can be given a harpsichord-like sound by doping its felts with lacquer to make them hard). The second and equally important part of the computer music model, then, is the way in which each note begins, builds up to its full volume and finally fades away to nothing.

Imagine a large pipe organ. When a key is pressed, air is forced under pressure into a metal tube. For the first few milliseconds, this air swirls and eddies around until the pressure has reached its full strength. Then it

equally-perfected traditional instrument without a lot of arranging. In general, look for simple music and use the complexities of the software package to make it sound right rather than exhausting the computer's memory and capabilities with complex music but leaving nothing to provide the control over the sounds you want.

That Bach trio can be done, but if you only have three voices to work with you'll probably be a lot happier with a strong melody line in one voice accompanied by percussion or harmony in the others. Even the kilobuck systems with 16-voice capabilities usually have to assign from two to eight of the computer's voices to each musical voice to get the desired sound and rarely end up with more than four music parts.

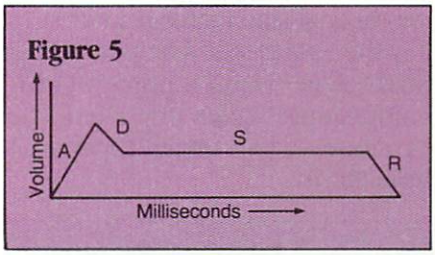
Try folk music. Most of it consists of just a melody line and percussion (washboards, drums, bones and other clicks and pops that a noise wave can imitate nicely). This same melody line is usually repeated over and over again with different instruments taking the lead each time, which a computer can easily do using a loop with a change of envelope or wave-form at the beginning of each repetition.

settles down and produces a standing wave as long as the key is held down. When the key is released, the air pressure at the pipe disappears almost instantly, but may continue fluctuating at the listener's ear for some time, especially in a large room with bare walls. As the note builds up to its full volume, it may waver both in pitch and amplitude. It also may momentarily reach a peak volume that is higher than it can maintain. Then, only a few milliseconds later, it stabilizes at, say, middle C if that is the key pushed and continues as a steady tone. When the key is released, the tone may stop quickly at the pipe, but appears to the listener to die away slowly because it bounces around the walls of the room for a while first.

This pattern is modeled by dividing each note up into four stages, not all of which need to be used for every instrument. The first stage is the attack in which each note rises from silence to its maximum volume. The second, decay, is a drop from the initial volume to the third stage, sustain, which is maintained for an indefinite time. The fourth, release, governs the drop in volume from the sustain level back to silence. Because these four stages enclose the waveform and limit its amplitude, they form what is known as an envelope that contains the note. Since the order of the four stages is attack, decay, sustain and release, the basic and almost universally used computer envelope is known as the ADSR envelope. It's illustrated in Figure 5.

When it's used with thought and experience, this highly simplified model of what actually happens when a string is plucked or bell is struck can give some surprisingly sophisticated control over timbre. In fact, an experienced computer musician can produce some striking orchestral effects from a square wave alone if he has full

Figure 5



control over an ADSR envelope. The 64's SID chip allows 16 different values for each of the four parameters. The attack stage, for example, can vary from two milliseconds to a full eight seconds, while the decay and release stages can be as short as six milliseconds or as long as 24 seconds.

Since 16 values for each of four parameters results in 65,536 different possible envelopes, some of which may not sound appreciably different from others and many of which may sound downright awful, some practice in envelope formation is useful. The best way to start is probably to examine, try out and think about various other instruments. We've seen how an ADSR envelope helps replicate an organ sound. A piano, on the other hand, has no sustain stage at all, but has a long fading away if the key is held down and a rapid fade when the key is released quickly as in a staccato passage. Thus, an ADR or simply AD envelope may work best for a piano or guitar. The sustain stage is there, of course, because it's built into the SID chip, but its duration is set at zero. A simulated flute would have a full sustain stage and a short release time. A drum has a very quick attack and fast decay with no sustain or release. Unconventional electronic sounds can be produced with long attack stages. Try out various envelopes and examine those done by others. By all means write down the parameters for envelopes you like so you can create them again. Since there are over 65,000 possible envelopes, you'll have trouble finding them again if you don't.

Digitizing

Once the waveform and envelope have been created, they have to be reduced to numbers so the computer can use them. This is no problem with a linear envelope, which is formed of easily defined straight lines. A complicated waveform like the one we created from two others in Figure 3 requires a sampling technique. Figure 6 shows how this works using the same waveform and also some of the pitfalls. The desired wave is the one on the bottom, which, you will recall, is the sum of 100 percent of a fundamental and 50 percent of its third harmonic. If we take eight samples per cycle and let the computer model the wave from only those eight samples, we'll have something like the middle wave, which gives the cor-

3. Arranging the music. After you've developed an instrumental sound that you like and have tried out a few measures of a piece to make sure it'll work with the simulated instrument you've settled on, you'll probably find that you need to make changes in the piece itself to make it come out the way you want. Don't be timid. Musicians have been arranging each other's work for centuries and it's a fully accepted procedure when you transfer music from one instrument to another. Some arranging techniques that are useful for computers include:

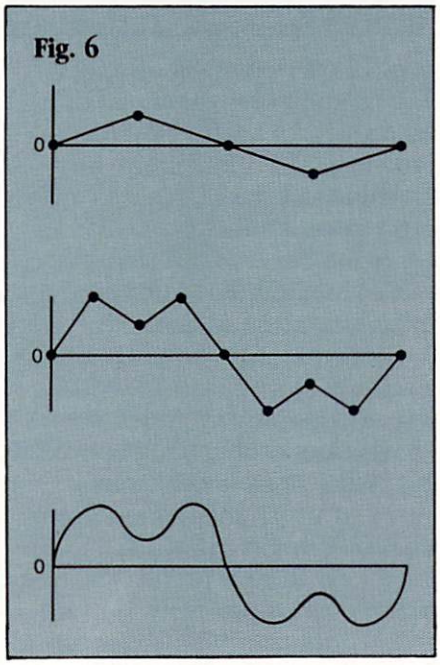
Transposing. Most combinations of waveform and envelope have a consistent timbre over a limited range, often only an octave or two. If either the low notes or the high notes of a piece you like don't sound right, try transposing the entire piece up or down an octave or two. If an octave is too great, try part of an octave. This will change the key but will leave the notes with the same relative pitches and is also considered a perfectly acceptable way to adjust a piece to a new instrument. Some music packages provide a transportation com-

rect idea at least. If we sample only four times per cycle, we'll end with the top wave, which is basically only a sine wave and has an amplitude of only about 50 percent of what we expected, at that. It is obvious that the more samples we take, the closer the sound will be to the desired complex wave.

After the samples are taken, they are entered into what is known as a wave table in the computer's memory. Like a shape table used for graphics, this is nothing but a set of numbers that form the instructions the computer is to execute in order. To produce a given note, the computer cycles through this wave table at the speed needed to create the correct frequency. For middle C, it goes through the entire table 264 times each second, changing the voltage put out by the DAC and thus changing the air pressure, eight times each cycle or 2,112 times a second. If we want the note C four octaves higher, the frequency required is 4,224 cps and the air pressure must be changed 33,792 times a second. If instead of eight samples for one cycle of the waveform, we had used 20, the computer would have to send 84,480 instructions per second to the DAC. The more the samples or the higher the frequency of the note, the more work the computer is required to do each second.

Although computers are incredibly fast, they still have a maximum speed and it's possible to have some combinations of large samples (which is the same as saying large wave tables) and high pitched notes that are impossible for the computer to perform. When that happens, either the computer slows down or it starts skipping instructions. In either case, the resulting sound isn't the one you expected. On the other hand, as we saw above, if the sample used to picture the waveform is too small, the computer may cycle through the table accurately, but the sound still won't be right. So the final sound is going to be a compromise within any given computer's memory and speed limitations.

Fig. 6



Filters and Modulation

One of the more interesting things about the SID chip is that, even though it is fully digital, it was designed to imitate an analog (Moog-type) synthesizer. This actually isn't a bad choice, since emulating 18th-century Italian violins is economically out of the question. At least this makes the Commodore sound like a recognizable instrument and eases the transition for those who are familiar with synthesizers. Therefore, the chip contains digital versions of standard analog controls including three filters—high pass, low pass and band pass—a ring modulator, a resonator and an FM modulator that serves somewhat the same function as an LFO (low-frequency oscillator).

Digital filtering is easy, in some ways easier than analog filter methods. A logical IF test in the program determines whether or not the filter is turned on and at what frequency it should begin filtering the sound and then simply changes the numbers in memory to correspond. It's merely a simple programming problem instead of complicated circuit design. The high-pass filter is designed to attenuate the volume of any frequencies below the one selected at a rate of 12 decibels per octave and to pass unchanged any frequencies above that. The low-pass filter allows the full spectrum below the cut-off point to pass, but reduces the volume of frequencies above that at the same 12 db/octave rate. The results are subtle and are similar to those from the bass and treble controls on a stereo. The band pass combines the two to reduce automatically frequencies outside the two cut-off levels at a 6db/octave rate.

mand that makes it easy. You may find that a simple envelope change brings notes that are outside the good range back into it. If you can set up your program to change the envelope during performance, you might want to do so whenever those notes are encountered. Alternatively, you might use one voice with the appropriate envelope for the high notes and a second voice with a slightly different envelope for the low ones. While devoting two voices to one melody line could cost you a voice, you might find that it's well worth it for some music.

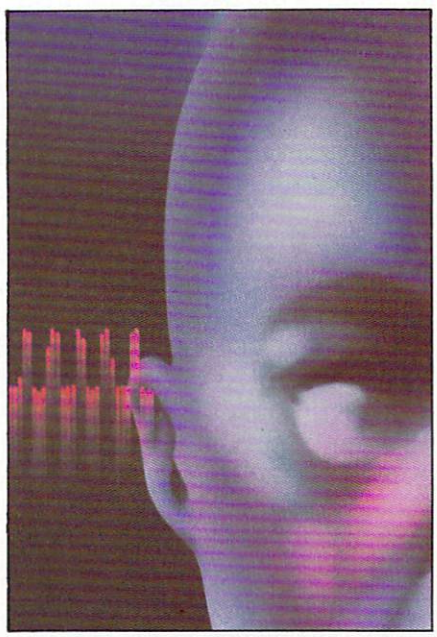
Triplets. Although the computer may be capable of performing notes of any duration (within the limits of binary arithmetic), some music editors allow only standard durations—whole note, dotted half, half, dotted quarter, etc.—and have left out variations such as triplets that can greatly liven up what would otherwise be a plodding, pedestrian rhythm. In that case, what you can do to get these non-standard durations is to change the tempo for the duration of the triplet

On a synthesizer or a studio mixer these filters are controlled by knobs or sliders, while the 64 requires memory POKEs. Some of the music editors that are available, however, allow you to use the function keys just as if they were continuous analog sliders.

The ring modulator is designed to imitate the ringing of a bell. When a bell or other piece of metal is struck, the waves travel out to the edges, where they are reflected back and perhaps around the circumference as well. As they are reflected through the metal, they reinforce and cancel each other in ways that set up overtones that are not part of the harmonic system we looked at above and which result in the distinctive bell, chime or gong sound. The purpose of the SID chip's ring modulator is to imitate that sound. Unfortunately, it's not as simple as turning on the ring modulator switch. The tempo, envelope, filter and pitch settings also help determine whether or not the sound will be bell-like. It may take quite some time to get what you want, but in experimenting to find these settings, you'll probably come up with some Hollywood science fiction sounds that will come in handy someday.

The last timbre-control functions built into the SID chip are synchronization, frequency modulation and resonance. They're not well documented anywhere, but the *Commodore 64 Programmer's Reference Guide* gives the memory locations and POKEs needed so that you can experiment to see what they do. Basically, the synchronization feature lets one voice control another and forces the second one to go back to the beginning of its wave table whenever the first one does. This prevents beating when one voice is slightly out of tune with the other. If both notes have the same pitch, this synchronizes the voices. If they're not, the combined waveform is very irregular and may or may not sound pleasing.

The frequency modulation feature, touched on in the guide only under a short section called "Advanced Features", allows voice



three to modulate the output of either voice one or two. Like an LFO on a synthesizer, this causes oscillations in the output of the controlled voice to give a "wah-wah" effect if the oscillations are slow and a vibrato or tremolo effect if they're fast. Virtually undocumented in the programmer's guide is the fact that the chip also makes possible 16 degrees of resonance by feeding back some of the filtered sound through the filter after a slight delay. This delay isn't long enough to provide a complete echo effect, but it does help fill out thin sounds.

Music Editors

We've discussed four envelope parameters with 16 settings each, four waveforms, one of which has 4,096 subforms for a total of 4,099, two filters, one with eight settings and the other with 256 and such other techniques as letting one voice control another via synchronization or frequency modulation and of course the choice of having resonance or not. If you multiply out the number of possible combinations from just these controls alone, you come up with 4.40126 E+12 or over four trillion different possible combinations. Those are the different possible choices of timbres for each note without considering pitch and such overall controls as volume and tempo.

Obviously, as we mentioned before, many of these will be so slightly different that they will be indistinguishable to the ear. Many more will probably not be pleasing, to put it mildly. That still leaves an awful lot of timbres in the SID chip that are useful to someone . . . How many? 100,000? A million? Who knows? Whatever the number, it's high enough so that the hit-and-miss method of rewriting and rerunning either

and then adjust all of the notes within that duration to fit. For example, if you want eighth note triplets (three- eighth notes in the time of one quarter note), you can increase the tempo of the piece by 50 percent and enter the three as eighth notes. To compensate for this in the other voices, add 50 percent to the duration of the notes. If they're already dotted notes, tie them to dotted notes of half their base value. Don't forget to return to the original tempo after the triplet.

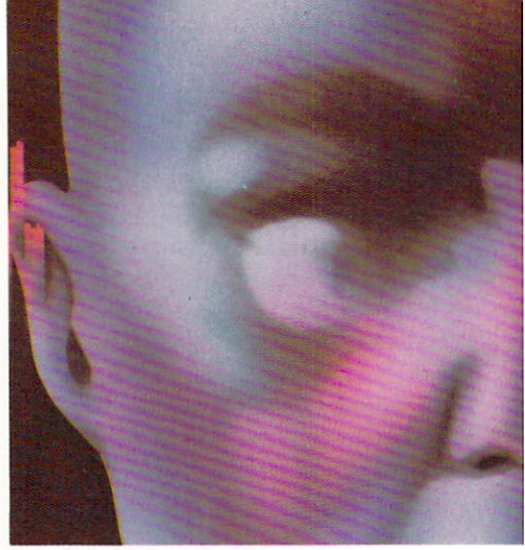
Staccato notes. If you can change the envelope on the fly, a quick decay usually produces a very satisfactory staccato effect. If you can't, or if the maximum decay rate your system allows isn't enough, cut the note duration and fill out the remaining time with a rest. For example, if the score calls for a staccato quarter note, you may be able to improve the sound quality substantially by entering it as a sixteenth note followed by a dotted eighth rest. The use of staccato is essential for percussion sounds because the noise waveform is most effective with a very short

BASIC or machine language programs with one or two parameters changed each time will make the programmer eligible for Medicare long before he's satisfied with his first envelope. However, if you really want to do music programming in BASIC or just want to learn as much as you can about the workings of the SID chip, the following two books will be useful: James Vogel and Nevin B. Scrimshaw, *The Commodore 64 Music Book*, Softtext, Inc., Cambridge, Massachusetts, and Bill L. Behrendt *Music and Sound, for the Commodore 64*, Prentice-Hall. The first, which is more music-oriented and comprehensive, is available with its BASIC programs on cassette, while the second, which tends more toward sound effects and ignores some sound controls mentioned here, can be purchased with its programs on disk.

Although, as these books show, it's possible to program music directly, the programming languages are normally used to create music editors, which are the musical equivalent of word processors. Some of these allow you to load and begin playing a song in three-part harmony if you wish and then to vary all of the parameters we've discussed while the song is playing and finally to save these on a disk as presets that you can recall and use as a group. Others pick sets of parameters that their designers like and limit you to the presets they've chosen, usually labeled harpsichord, piano, etc. Several of these editors are reviewed elsewhere in this issue or are scheduled for review in future issues. Some accept music entry graphically using a musical staff and notation. Others require entry in code, perhaps by note letter, octave number and duration.

When you're choosing a music editor, at least three criteria are important. The first, as you are probably painfully aware from other software you own, is its documentation. If you can't understand how to make it work, the wonderful sounds coming from your dealer's demonstration disk don't do you a bit of good. Check to see what language it's written in. Some of the packages are written in computerese by and for experienced hackers, while others assume you are already an expert with an analog synthesizer. If the instructions talk about VCO's and LFO's (voltage controlled oscillators and low frequency oscillators), you may find that you need to take a course in how to play an analog synthesizer first. Straightforward English, is best, of course.

Ease of use is probably number two, but this may conflict with number three, complete control over all of the SID chip's functions. A dozen or so presets labeled with the names of conventional instruments may be all you want. It certainly makes the job easier, but you may regret not having full control over the SID chip in the future. Similarly, it may be easier for you to enter notes graphically on a musical staff, but this may limit you to the conventional 12 notes per octave. It is possible to play in between frequencies with the SID chip by POKing numbers between those of the note frequencies. This allows quarter tones, slides (portamento) and vibrato effects, but the editor must be able to take advantage of these capabilities. Another criterion that may be important is whether or not the piece created with the editor can be appended to either a BASIC or machine language program and called by it. Some editors make this possible, but others don't.



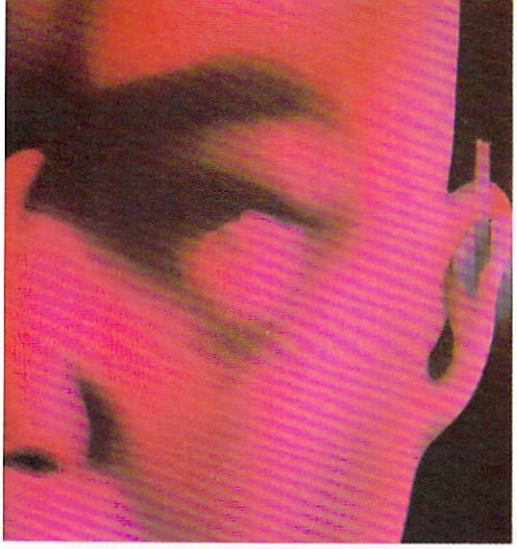
The Future

Despite its versatility, the SID chip is limited because it offers only three voices and has only predetermined waveforms. Music cards that plug into the slots of some other microcomputers offer up to 16 simultaneous voices and allow the user to create almost any waveform by specifying up to 24 harmonics and then to play the music through any standard hi-fi system and in full stereo.

Since one of the I/O ports on the back of the Commodore 64 is a direct connection to its buss,

note that has a sharp attack and decay.

Fast notes. The different sounds of different waveforms are obtained by having the computer cycle through a wave table in memory at the speed necessary to produce the desired pitch. To reproduce an A four octaves above middle C, for example, the computer has to go through the entire table 7,040 times a second and at the same time check to see where it should be in the envelope. If the notes get too fast, sometimes the demands exceed the computer's ability to do all of this on schedule. When that happens, sometimes it slows down and the tempo varies slightly. At other times the notes may be programmed so close together that there's no time for the entire envelope to be heard and subsequent notes may begin during the attack stage of the preceeding note. This clips the note short and may result in clicks, pops, screeches and other unpleasant noises. One solution for this that may work for you is to devote two computer voices to one music



there is no reason why similar packages couldn't be designed for it. However, it appears that this step in the evolution of microcomputer music is going to be skipped in the case of the 64, probably because the SID chip already provides substantial music abilities. Instead, design engineers for synthesizers and electric organs are teaming up with software authors to build interfaces that will allow computers to control their electronic instruments directly and to utilize all the sound capabilities they already contain.

Five uses for of 64/synthesizer interfacing are in the works or on the market. The first is note entry via a piano-style synthesizer keyboard. By itself, all this does is make it easy for a trained pianist to enter notes that will be stored in memory and later played back via the SID chip. The second is the use of the computer as a sequencer, a device that stores notes by pitch and duration and directs the playback through some device. When the computer is playing a piece through the SID chip, it's acting as a sequencer, of course, but the current thrust is to use the digital memory of microcomputers to operate several much more complicated stand-alone synthesizers at a time, including drum machines, electronic organs and electric pianos.

The third approach is to enter the various presets—envelope settings, waveform, filters, volume, etc.—into the computer's memory with an interface that controls an external synthesizer. This allows a performer to change complete timbres by hitting one number or letter key on his computer keyboard without breaking the rhythm of a real-time performance on the synthesizer's ivory and ebony keyboard. A fourth feature is a score writer which analyzes the notes entered by a synthesizer's piano-style keyboard and prints them polyphonically as a full score using high-resolution graphics.

A fifth use for the computer is that of serving as a recording studio. With the proper software, it's possible to record one track at a time from a synthesizer keyboard and store each track separately in memory and on a disk. Each can then be edited as needed and then finally mixed down by the computer to the two channels needed for stereo. Even more exotic is the possibility of having the computer record synchronizaton signals on one track of multi-track tape and later use those signals as its own clock so that it will play in time with music already recorded on other tracks of the same tape.

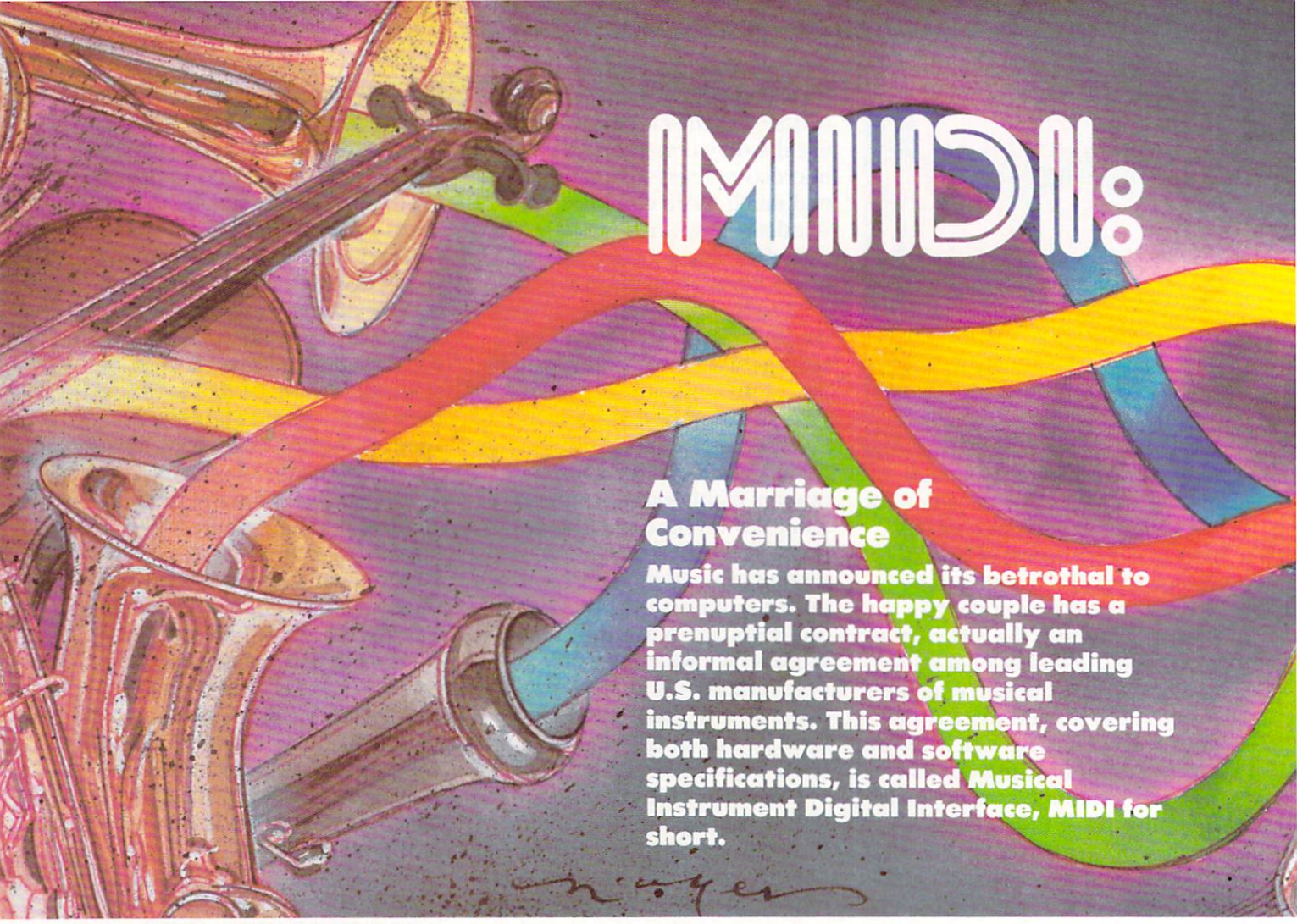
What's on the horizon for the future? Frankly, it's almost impossible to tell because both the software and synthesizer markets are so competitive that nobody's willing to talk. One would say that the limits of the SID chip have been reached and that any new packages would be me-too imitations of the existing ones—except that a very easily understood human voice synthesizer was recently introduced for the 64 that uses (believe it or not) the SID chip to speak its words! Work on MIDI has barely begun and we can expect to see substantial advances there including, perhaps, a fully polyphonic score writer and full control over additive wave forms (both of which are already available for the Apple). Certainly the number of 64's being used at the NAMM show to operate synthesizers of many kinds suggest that it is finding its niche in both amateur and professional music production. [For more on MIDI interfaces, see Peggy Herrington's article on next page.] C

Christopher U. Light's articles have appeared in such diverse publications as *Creative Computing, Softalk, SoftSide*, the *Journal of Political Economy* and the *National Geographic*. His first album of computer music, "Apple Compote" was issued by Softalk Publishing, Inc., in 1983, while his second, "Apple Folk," is scheduled for release by Kicking Mule Records in early 1985. This article represents his first experience with the Commodore 64 and the SID chip.

voice and alternate notes with rests in between each of them in the same duration as the missing note. When a rest stops a note, it doesn't cut it off completely but instead triggers the release stage, which allows the note to fade away normally.

Legato Notes. A goal of much classical music is that it be played legato, smoothly with the notes connected. Some packages automatically insert a short but audible rest at the end of each note to allow the system to reset itself. This can be gotten around by using two voices as for fast notes, but overlapping the notes slightly. A string of quarter notes, for example, would be entered in voice one as a quarter note tied to a sixteenth note followed by a dotted eighth rest and in voice two as a dotted eighth rest followed by a quarter note tied to a sixteenth.

As you gain experience, you'll come up with more tricks the meantime, happy programming . . . or performing . . . or whatever the heck it is we're doing when we're making music with a computer. C



MIDI:

A Marriage of Convenience

Music has announced its betrothal to computers. The happy couple has a prenuptial contract, actually an informal agreement among leading U.S. manufacturers of musical instruments. This agreement, covering both hardware and software specifications, is called Musical Instrument Digital Interface, MIDI for short.

By Peggy Herrington

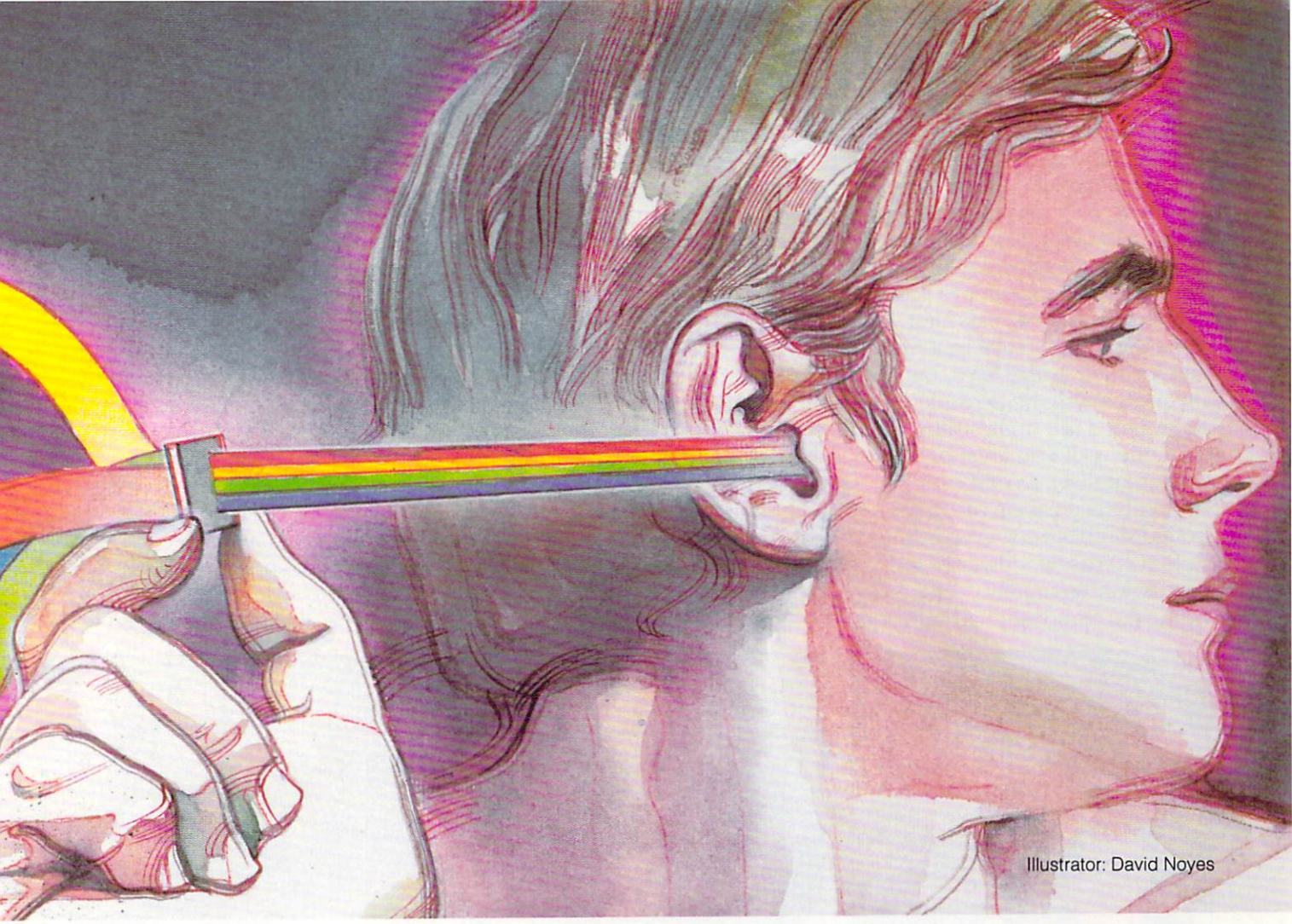
Electronic musical instruments have contained microprocessing chips for several years now and some even have CPU's for control of performance parameters. In fact, descriptions of many professional synthesizers read a lot like those about our own SID chip. These dedicated digital musicians don't house anything as sophisticated as the Commodore 64 of course, or the VIC 20 for that matter, but like computers, each brand does things in its own way.

MIDI came about as the result of a need for compatibility between various types and brands of music synthesizers. Along with this came the realization that getting the power of personal computers into the act would be good for everyone. So MIDI not only provides communication between musical instruments, it forms a bridge between two of the fastest-paced technologies in the world today—music and computing.

Armed with a formal background in music (of the acoustic type, not synthesis—although I've been known to program a mean SID chip) and a working knowledge of the Commodore 64, I set out to investigate this MIDI business with a group of friends from the New Mexico Commodore Users Group. In varying degrees, most of us knew something about music and the Commodore 64, but none of us knew much, if anything, about the practical applications of MIDI. We realized right off that we would need some equipment, so a few phone calls and days later, a Six-Track professional keyboard synthesizer with MIDI hardware and software from Sequential Circuits was delivered. Passport Designs also generously loaned me their MIDI interface and four-channel software.

Two members of our MIDI research team have their own digital music-makers so we decided we'd try to hook their machines to the Sequential Circuits Six-Track. Jim Drake, once a performing musician who now teaches guitar, brought his Roland TR-808 Rhythm Composer, a very sophisticated drum machine and George Collaer, a middle school music teacher, arrived with his Yamaha DX-7. Also on hand were Vic Balderrama, an experimental composer and guitar player, Patsy Taylor, 64 user and graphic artist, and Jorgie Winsberg, a former professional keyboardist. My husband Pat, who has a limited interest in both music and computers (but has graciously resigned himself to user group gatherings like this), offered to take charge of organizing the electronic end of it.

In all, our MIDI experiment en-



Illustrator: David Noyes

compassed two different keyboards, a drum machine of yet another brand, two MIDI interfaces with software, a 64 with disk drive and monitor, amplifier, speakers and seven musicians.

MIDI-equipped instruments, like the MIDI interface, have two 5-pin female DIN connectors labelled MIDI-in and MIDI-out (some have a third called MIDI-thru). We decided to make the DX-7 the master keyboard and the Sequential Circuits Six-Track the slave. We ran a cable from MIDI-out on the interface (plugged into the 64's expansion port) to MIDI-in on the DX-7, another cable from MIDI-out on the DX-7 to MIDI-in on the Six-Track and then more cables going back (connecting -ins with -outs) between the two synthesizers and the interface.

When we tried to put the Roland drum machine into our system, we discovered that this model, although less than two years old, is not a MIDI device and wouldn't work when plugged directly into the MIDI interface with a ¼" phono plug lead.

The Passport Designs MIDI instructions explained how to connect several non-MIDI drum machines through their sync input. So we powered down and switched to the Passport Designs interface and software. Everything worked just fine. If we had a "Y" DIN cable to connect the sync input from the drum machine to the Sequential Circuits interface, it would have worked, as well.

Our MIDI team and my neighbors agree that it measured up in terms of fun and music making. Our experiment was a roaring success! But I doubt that any of us would recommend such a gathering as the best method of checking out MIDI because one of the strengths of MIDI is that a single musician can, at leisure, prerecord voices one at a time (it's called laying down tracks) on any and all of the instruments at his or her disposal and play them back later fully synchronized in a recording studio or onstage. The musician can then play and sing along with that as accompaniment in real time. This is not only for convenience, it also changes the very nature of making music.

For instance, have you ever wondered why the album version of a favorite song sounds fuller than a live performance of the same piece by the same group? That's partly because more instrumental parts than can be physically played by the group at once are included on the record. Sounds were overdubbed (putting a recording of one instrument with another already on tape) in the recording studio for the album version. Until the development of MIDI—with the management and memory capabilities of a computer—the only way this could

be done onstage was by using additional equipment and musicians.

And talk about control! Composers of multi-part music have always had to write the music and then wait until sufficient musicians were gathered together to actually hear it. This can be years later, and some composers have waited in vain for their entire lives. But not any more. With the possible exception of a full orchestral score (and one could do an abbreviated version of that), a composer can enter all the parts on MIDI-controlled synthesizers—recording violins, horns, woodwinds and percussion separately—and, providing the composer had sufficient

Jorgie trys out some of the S.C.I. Six-Track's preset sounds while Peggy (the author) and Jim Drake watch the monitor display as the C-64 manages memory.

equipment (eight synthesizers is the maximum MIDI can now coordinate), hear it played on the spot by pressing a few keys on the computer. A composer is not limited to using a piano-type keyboard for note entry, either. Roland, for example, makes a digital guitar that can emulate acoustic instruments or create new sounds.

Speaking of technique, the skill—or lack of it—with which a performer plays an instrument is greatly enhanced with music synthesis. For live performance, of course, a musician must still be able to play with a degree of finesse, but if you're laying down tracks for accompaniment or studio recording later (and especially if you're just fooling around), you can't beat a synthesizer!

Select the recording feature and set the built-in metronome (or drum machine if you have one) at a comfortably slow rate. If you don't want multi-instrument music, you can play all parts at once, like a piano. But if you're after differing timbres, you enter one instrument or voice of the music at a time on the keyboard, very slowly. This way, you can get the notes, durations and timing right without concerning yourself overly with technique. Then play back the first voice and record the second by playing it on the keyboard with a different instrumental sound.

After you've entered all the

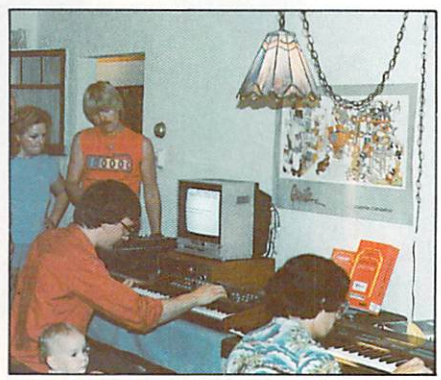
The author adjusts a setting on the S.C.I. Model 64 MIDI interface, George and Vic take the opportunity to discuss making music on S.I.D.

parts, it's a simple matter of adjusting the overall tempo to get the piece up to the speed you want. It's not like playing a 33⅓ rpm record at 45; increasing the playback tempo doesn't alter the pitch on a synthesizer.

In our MIDI experiment, the DX-7 was the master and the Six-Track the slave. With the 64, we digitally recorded George as he played several pieces on his DX-7. (Anything in RAM on the 64 can be saved to disk, of course.) Then we played the music back on the Six-Track while George filled out the harmony and added trills with the DX-7 in real time.

Pitch bending (a gradual, as opposed to step increment between pitches) is widely available on synthesizers, but is often operable only in real time. MIDI not only lets you save pitch bend and other performance parameters for later playback, but, provided both machines have the capability, transfer instructions from one machine to the other. This is controlled by MIDI and it's in areas like this that MIDI can get you into trouble.

The slave synthesizer must obviously be physically equipped to



MIDI Investigation Team at work: George, Peggy and Jim (standing, left to right) consider Pat and Vic's Keyboard technique.

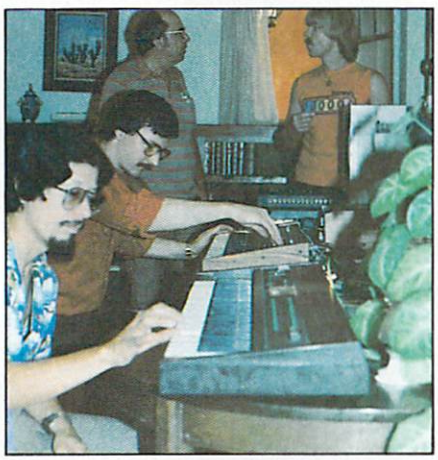
Photos By Dale Rankin

accomplish bending (or perform any special features which may be available on the master) because MIDI is only a communications tool. Then too, like computers, it depends on how it's done. The master synthesizer might bend the pitch down a third while a slave of a different brand might interpret the same instructions to mean bending the pitch a full octave.

MIDI is an evolving standard and as of July, 1984, is still in its first version. Flawless communication and compatibility between various synthesizers will have to come with time. I'm convinced it will. One of the beauties of a modular music system under computerized control is that upgrading equipment and buying new soft-

ware is relatively inexpensive. Obsolescence is greatly reduced.

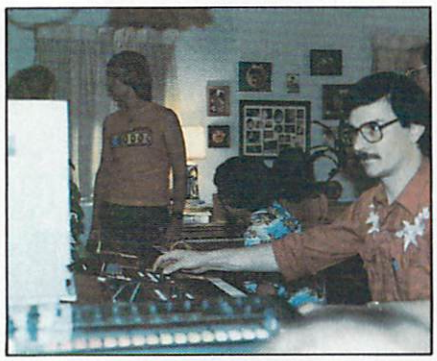
Writing MIDI software is a wide open field and manufacturers of digital music instruments, as well as independent software producers, are clamoring for programmers with time on their hands and musical knowledge. If you're a programmer and if, like me, you've had a Commodore 64 long enough to remember when there wasn't much software available for it, take heed! It won't be an open market for long, even though the musical applications seem endless. Not only is sophisticated recording and performance software needed, but printing sheet



MIDI Investigation Team at work: (left to right) Vic and Pat on keyboards; George and Jim try to get the non-MIDI drum machine into the system.

music and music education—learning standard notation, theory, intervals, ear training, rhythm and meter and performance techniques—are musical skills which lend themselves to computerized instruction and must be approached through software. MIDI software and hardware specifications can be obtained from many instrument manufacturers or the International MIDI Association (I.M.A.).

Above and beyond the fact that a marriage between electronic musical instruments and computers—performed by MIDI—is functional, expedient and powerful, one aspect alone makes it worthwhile. It's fun! The first thing Jorgie, one of our musically knowledgeable MIDI experimenters, wanted to know was how to select the waveform and set the sound envelope (the attack, decay, sustain and release) to create a voice on the Six-Track. I explained that she could design her own, but there were 99 presets available at the flick of a button or two. And there were 168 available on the DX-7. Her eyes opened wide and she regaled us with horror stories of band members pressuring her to hurry with the settings when she was playing keyboards professionally. Her equipment had no presets available—she couldn't



Pat makes a little MIDI music while the hard-working MIDI team takes a break.

even save those she designed herself from one time to the next—this was the worst aspect of her nightly performance.

And Pat (the one who was just supposed to take care of the electrical connections) will tell you, if you can pry him away from a keyboard long enough for an intelligent conversation, that those presets and the ease of playing make all the difference. He composed an untitled multi-part piece, one track at a time, using some of the wildest presets. We saved his masterpiece to disk for posterity and it is an audible testimony to the fact that synthesizers, through the auspices of MIDI, allow even a non-musician to create complex musical showpieces.

The I.M.A. is a nonprofit corporation that serves as an information resource and noncompetitive clearing house for MIDI. Membership is open to anyone interested. A monthly newsletter, access to an end-user dedicated database, a copy of their MIDI Specification Pamphlet with support materials and I.M.A. member discounts and services accompany a one-year end user/technician membership for $25.00. (Contact I.M.A., 8426 Vine Valley Drive, Sun Valley, CA 91352 or call (818) 767-0597. Inquiries about the MIDI telecommunications network, "I'm On", which does not come under the I.M.A. nonprofit umbrella, can be addressed to the same location.

I'm further convinced that the Commodore 64 is the computer which is best suited for MIDI applications. There is some MIDI software now for several types of computers, but as you no doubt know, software availability frequently determines the brand of computer used. Most professional musicians will have to go out and buy a computer for MIDI control of their synthesizers. The flexibility of applications and economics of Commodore products make them more attractive than their counterparts on the market today.

There's a vast new horizon in sight for musicians through the MIDI. An application for the Commodore 64 under development by Richard and Ron Grant with J.S. Cooper Electronics promises control of awesome proportions for composers of film scores (motion pictures, TV and radio commercials). "Auricle: The Film Composer's Time Processor" (see *Commodore Microcomputers* July/August, 1984, Industry News), endowed with MIDI and music synthesizers in tow, will provide an individual with everything but the tune to compose, adjust meter and tempo, orchestrate and produce a polyphonic musical sound track fully synchronized with the film's dramatic action. (For details, contact Richard Grant, 3828 Woodcliff Road, Sherman Oaks, CA 91403.) **C**

Ryo Kawasaki:

What happens when you put a talented musician next to a Commodore 64? Some sophisticated sound unlike any other.

Sonic Innovator

By Bill Milkowski

Entering Ryo Kawasaki's apartment in Manhattan Plaza is as intimidating as confronting the awesome, blinking mothership from *Close Encounters of The Third Kind.* Visitors are greeted by an imposing arsenal of all the electric hardware he's accumulated since coming to the States in 1973. This spider's web of patch-chords, wires, Oberheims, Korgs and countless other sound enhancers takes up an entire wall in his cozy living quarters. With all the pulsating red and green lights and blinking LEDs, the whole contraption looks alive.

This hardware piled up along one wall represents all the sonic excursions that Kawasaki has undertaken in the past ten years of working on his solo albums. But what occupies most of his time and attention these days is not his many rhythm machines or synthesizers or even his trusty guitar. It's the Commodore 64.

Since acquiring the 64 just two years ago, the Japanese-born musician has been spending most of his waking hours seated at the screen, working up innovative new software for the unit.

"My average working day is eight to ten hours," says the soft-spoken programmer-guitarist. "But when I'm really into it, I can spend 15 hours a day trying to solve problems that arise."

Kawasaki's exhaustive efforts have resulted in two new music programs for the 64. His Kawasaki Synthesizer and his latest, the Kawasaki Rhythm Rocker, are both being marketed by Sight & Sound International whom he has been associated with for the past year.

It was at a music fair in Tokyo that the two parties met. As Ray Taborshak of Sight & Sound recalls: "I had heard about this guy who was doing some amazing things on the Commodore 64, so I made a point of finding him and checking it out for myself. Of course, I had known about Ryo from his work as a sideman with Gil Evans, Elvin Jones, Chico Hamilton and other jazz artists, but I had no idea he was involved in computer music."

Taborshak, himself a professional jazz pianist for several years before joining the staff at Sight & Sound, was instantly taken by the inherent musicality of the Kawasaki synthesizer program.

"Ryo had very hip things in his demo program. It wasn't stiff or cliche like so many of the other music programs I had seen. His arrangements were full of nuance and subtlety. He captured the feel of jazz voicing and phrasing. And it swung," Taborshak said.

Amazingly, Ryo had only begun experimenting with the 64 just one year before meeting with Sight & Sound in Tokyo.

"I started programming by March of 1983, a few months after I had bought the unit," he says. "I had no experience with programming. I am basically a musician. In fact, in the beginning I was not a very good programmer at all. I was working with BASIC and didn't even know about machine language. People had told me that machine language was difficult to work with, but because I have extensive background in audio physics (he earned a degree in physics from Nippon University in 1969), I took to it quickly.

"So by May of 1983, I finally got something into shape and began showing my program to different firms in Japan and the United States. A few of the software companies were interested in what I was doing, but the problem was that they didn't know anything about music. They had no feel for it or experience with it, so they really were not in a position to properly deal with it. Some of the bigger companies were too preoccupied with trying to keep up with their hardware orders to get involved in a whole new venture like music software. But Sight & Sound had the musical background and firsthand experience with music to be able to appreciate what I was doing."

Sight & Sound president Zeb Billings, who played professionally during the big band era as a saxophonist, began as an organ retailer and gradually expanded the company to reflect technological advances. Today Sight & Sound is well versed in bar coding, digital tape, floppy discs and SID chips, dealing with manufacturers like Casio, Roland, Technics and Seiko. They program ROM packs for the Casio MT-201 and the MT-800 and now they've entered the burgeoning field of music software with Ryo Kawasaki as their house programmer.

Photos by: Darryl Pitt

"I'm working in terms of two microseconds. That's how I relate to the machine."

Kawasaki is a particularly precise programmer. He pays great attention to fine details (like the toe of one character tapping accurately to the beat of the music in his Kawasaki synthesizer program) and is a master at orchestrating time. But what is perhaps most astonishing about Kawasaki's program is the sheer number of things happening on the screen simultaneously. Besides the basic three-voice standard that the 64's sound chip allows, he has some very sophisticated graphics flashing on the screen. There's even an option for drawing geometric designs on the screen while the music is playing.

"I go back and forth with graphics and sound," he explains. "Always, the limitation is the memory of the computer—64K. When I use memory solely for graphics, I can get some incredible graphics. But when I use sound and graphics, there's a compromise. And in that compromise, I'm also challenging the limits of this hardware."

Because Kawasaki works with op-codes rather than assembly language or BASIC he can reserve more memory for other tasks. Working at such a fundamental level, he is truly in accord with the machine. He goes straight to the heart of the computer—all those ones and zeroes—getting maximum efficiency out of the machine by keeping track of all op-codes in his head rather than wasting any memory by letting the machine do it.

It's a very tedious method of programming, which explains why Kawasaki may spend up to three months on one program.

"I'm working in terms of two microseconds. That's how I relate to the machine," he says. "If any part of the program takes more than 16 milliseconds, it's going to crash. So everything I do has to be done within 16 milliseconds. That's the critical timeframe that I've determined."

The result is that he has that much more control over his programs. But as intricate, complex and tedious as that may be, Kawasaki's music software is surprisingly simple to deal with.

As the programmer himself says: "It's for people who don't have musical knowledge, but have the interest. If someone doesn't have a rhythmic feel, he or she can just play the notes and the computer will play the groove. Basically it's just a little toy, but if you want to get into it, you can create something. I believe that you don't have to know anything about music to make music. I am really encouraging the user to just play around and have some fun. You can really go wild with this program."

His Kawasaki Synthesizer program comes in two versions—the performer and the composer. Each program works within two microseconds. The composer version allows for the user to fill in at random any sequence of notes in three grids on the screen, each representing a single voice. The performer allows for more variety and choice in the sounds available with the pre-programmed demo tunes. (Kawasaki's demo pieces with the performer version include a fugue, calypso, jazz-blues and an Oriental-flavored new wave rock number he calls Japunk. There's even a tune inspired by legendary *avant garde* jazz composer Ornette Coleman.)

There are a lot of surprises in Kawasaki's software. He's proven to be a very skillful programmer with a knack for injecting nuance and feeling into his op-codes.

"Usually, I am inspired by the

Kawasaki is a very skillful programmer with a knack for injecting nuance and feeling into his op-codes.

hardware," he says. "So whenever any new, economical hardware comes out, I get very excited. I'll get it, study it, experiment, then try to push that hardware to the limit. Then it's over and I move on to the next new challenge."

Before the Commodore 64, Kawasaki was immersed in exploring the possibilities of the Roland guitar synthesizer. But in his never-ending search to expand the voicings of his instrument, he went beyond the capabilities of the Roland GR-500.

The 36 year-old guitarist-composer-programmer continues to perform with his group, The Golden Dragon, and record albums under the Japanese CBS/Sony label. His latest release, *Lucky Lady,* includes original compositions and rearranged versions of such classic jazz tunes as "Caravan" and "Sophisticated Ladies," all performed on his Commodore 64. His transcriptions of Igor Stravinsky's "Rondes Printanieres" and Maurice Ravel's "Forlane" feature very subtle, nearly subliminal use of synthesized, textural washes in the background. His most ambitious use of the 64 to attain lush, orchestral effects comes on "Secret Of The Wing," which also features some of Kawasaki's fiercest Hendrixian guitar work.

Kawasaki also continues to sit in on the occasional bebop gig around Manhattan, just to keep his guitar chops up. But given his current obsession with the potentials of computer music, he seems more at home with floppy disks and sound chips than he does in the smokey ambiance of after-hours jazz clubs.

Of his current passion for programming, Kawasaki says, "The problem all along has been that programmers had the technique, but they didn't know music. And while musicians know music, they don't have the same adeptness with the technology. So for all this time, there has been no communication. They remained in two different worlds. I often thought that if a great musician and a great programmer could ever get together, they could produce something really great. Now, I am bridging that gap. I can communicate with both worlds. Unlike some musicians, I am not afraid of technology. I believe that some good artistic media can be created with that technology."

"The Roland was a good foundation, but it couldn't deliver all the colors that I wanted to project. All the sounds were in my head and I was trying to reproduce them by experimenting with sound enhancers that I patch-chorded into the original unit."

His natural curiosity and uncanny knack for electronic dabbling ultimately led him through trial-and-error sessions with the Roland. His work with that unit was well-documented on his 1980 CBS/Sony album, *The Golden Dragon Live.*

Kawasaki's pioneering work with computer software is just a natural extension of his ongoing interest in trying to capture those other worldly, ethereal sounds floating around in his head. Now the 64 is allowing him to take great leaps at an astonishing pace.

As Sight & Sound's Taborshak puts it: "Ryo hears a sound in his head, then he goes after it. He doesn't play around with numbers and try to get the sounds first. He hears what he wants and he knows what he's looking for. If he sees a barrier, he logically eliminates it. His brain is operating at such an accelerated rate when he's in this creative mode that he will be able to expand that much faster as technology catches up to him.

"Ryo is always just a few steps ahead of technology. He's just incredible in that sense. By the time all these things catch up to where his mind is at now, he'll again be out in front on some new plateau. He always stays ahead of the game, because he is truly a cosmic character." C

The 20th Century One-Man Band

New software and hardware for the Commodore 64 put computer music literally at your fingertips—whether you're a novice or a pro.

Illustrator: Robert Neumann

By Peggy Herrington

Remember the old-fashioned one-man band? Like Dick Van Dyke in "Mary Poppins," he strapped on every portable piece of musical paraphernalia he could find: cymbals, accordion, whistles, horns, even a drum on his back, which sounded with every step. The contemporary version of this performer—the line musician who appreciates variety—takes an extraordinarily different approach. He's more apt to be at home with a computer and CRT and what he sacrifices in mobility, he more than makes up for with diversity—not to mention quality.

At the 1984 Summer Consumer Electronics Show in Chicago, some exciting musical hardware that accesses the SID music synthesis chip in the Commodore 64 was introduced and making music with the 64 will never be the same. You probably know about SID's three-voice programmable synthesizer since you know about Commodore, but knowing about it and playing it are two vastly different things.

Now using SID is as easy as 1-2-3-4 and exponentially much more fun, thanks to third party developers who've joined the Commodore concert right on key with piano-type keyboards that plug directly into the computer. You don't even need to know what POKE and DATA mean to become a 20th century one-man band.

One of the most exciting products is a full-sized, polyphonic three-octave keyboard from Melodian Inc. (115 Broadway, Suite 1202, New York, NY 10006). It comes with software called *ConcertMaster* and it turns your 64 into a standard music synthesizer with a builtin recording studio.

The 64's voices are color-coded on the standard music staff (treble and bass) that appears on the monitor. Want to learn how to read music? Just press a key on the Melodian keyboard and the note instantly appears on the staff. Notes can be automatically recorded as you play, either one, two or three voices at a time (with overdubbing) and are easily saved to disk. You can play with as much expression as you wish (no more regimented rhythms!) or follow the beat of the builtin metronome. Notes can be entered very, very slowly and the overall tempo of the music adjusted later.

Unlike a record player, a synthesizer does not change pitch when you increase the tempo. You can switch on (and off) a little graphic piano keyboard at the bottom of the screen and watch the keys change color to match the voices while the music notation scrolls past. You can use the 16 prerecorded instrument sounds available for each voice independently or you can design your own. And you can change the orchestration during playback. An ADSR menu allows access to all of SID's features for each voice.

All commands are controlled by the eight function keys and a menu is on the screen at all times. The 40-key Melodian keyboard retails for $200.00 including the *ConcertMaster* disk and documentation. *ConcertMaster* is also available separately since it works with or without the keyboard.

Additional software from Melodian, Inc. includes *Melodian MelodyMaster*, which teaches musical notation and pitch and has an optional hear-only mode that teaches how to play by ear. *Melodian RhythmMaster* is similar in concept to *MelodyMaster* and teaches musical timing through the use of color-coded notation.

Songs made popular by Michael Jackson, Willie Nelson, The Beatles and Paul Simon, for example, are on "Sight & Sound's" four computer song albums for the 64 ($24.95 each).

Waveform Corp. (1912 Bonita Way, Berkeley, CA 94704), the people who produce the exciting and elaborate *MusiCalc* software, reviewed elsewhere in this issue, has two very different musical keyboards available now. Their Colortone Pro keyboard is a polyphonic piano-style full travel keyboard with 37 keys (three octaves plus one key). There are two colorful, touch-sensitive strips across the top; one lets you strum with harp, arpeggio and glissando effects and the other is for preprogrammed scales and bass configurations. The Colortone Pro works with *MusiCalc* and the interactive template disks. This professional performance-quality keyboard retails for $399.95. It comes with full documentation and performance software and an interactive synthesizer tutorial on disk. Using the Colortone Pro keyboard is much easier than playing the Commodore ASCII keyboard, even if you've had no experience.

The other keyboard from Waveform is called the Colortone keyboard and is a vastly different device designed for a vastly different user. This one plays two octaves plus one note and is a flat, touch-sensitive keyboard with no key action (the effect is much like a graphics tablet you use with your fingers). It comes with a cable to plug into the joystick port on the 64 and, like the Colortone Pro, has a touch-sensitive strip for harp, arpeggio and glissando effects. It, too, interacts with *MusiCalc* and its templates and lets you record music on a disk to play back or print later. It also comes with an educational program especially for kids of all ages, which includes a musical game and eight prerecorded songs. The price is $79.95. Other educational software disks are planned for the Colortone keyboard including *Scale Attack, Intervals, Chords, Melody* and *Rhythm* .

New products accessing SID were also shown at Summer CES by Sight & Sound Music Software, Inc. (3200 S. 166th Street, New Berlin, WI 53151). This company has been in the music business for 18 years and holds thousands of copyrights for music.

Songs made popular by Michael Jackson, Willie Nelson, The Beatles and Paul Simon, for example, are on "Sight & Sound's" four computer song albums for the 64 ($24.95 each).

The albums are *Music Video Hits*, *On-Stage*, *Solid Gold* and *Rock Concert*.

Although these albums stand alone (you can use a joystick to alter instrumentation, tempo and special effects), they are made more versatile with Sight & Sound's *Music Processor* ($34.95 with 80-page documentation), a program using standard music notation for composition, which includes 12 prerecorded songs.

A third interactive program from Sight & Sound, *Music Video*

Kit ($39.95), is a graphics processor and includes a joystick paint program, sprite and character editor and a bonus album of songs. You can use this with the computer song albums and *Music Processor* to coordinate graphics with the music (there are some dazzling examples) or design your own.

The Incredible Music keyboard from Sight & Sound ($49.95) works with all their music packages and features movable mini-piano keys that fit over the 64 casing. This turns the top two rows of the ASCII keyboard into a musical keyboard. The package includes a disk and two books: one for the beginner and one for the more advanced musician.

Tune Trivia ($34.95), a disk of four music trivia games for one to six players and *3001 Sound Odyssey* ($39.95) are new from Sight & Sound, also.

Professional jazz musician Ryo Kawasaki (who is also a composer, physicist and programmer) performed at CES with guitar input through the 64 and his Kawasaki Synthesizer program—a two-disk package including *The Composer* and *The Performer* for $49.95. This package and the Kawasaki Rhythm Rocker ($39.95) have an oriental music and graphics flavor which provides an interesting change to what is usually heard from the 64. (For more about Ryo and his music, see page 51.)

Although it isn't a true compositional keyboard, a new game from DesignWare (185 Berry Street, San Francisco, CA 94107) for kids aged five to ten features a realistic musical keyboard overlay of black and white keys for the 64. *The Notable Phantom* ($49.95) teaches basic piano and note-reading skills with onscreen ghosts, spiders and a mysterious phantom.

A little toe-tapping, baton-waving sprite maestro teaches children ages nine and up the rudiments of music on the treble clef in Human Engineered Software's (150 N. Hill Drive, Brisbane, CA 94005) *Bravo!* ($24.95). The first in HES's Magic Music Series on the fundamentals of music, *Bravo!* is monophonic and requires a joystick for standard notational input of your own music (which can be saved to disk). You can also alter the movie themes from "Starwars," "Superman", "E.T." and "Raiders of the Lost Ark" which are included on the disk.

Bank Street Music Writer ($49.95), new from Mindscape (3444 Dundee Road, Northbrook, IL 60062), is a full-fledged music editor. Featuring colorful high-resolution graphics which include treble and bass clef, bar lines, repeat signs, triplets, dots, ties, sharps, flats, naturals and key signatures, it displays three voices—concurrently, separately or in any combination—and can store the equivalent of 8000 notes in memory and print out the score as well. There are independent controls for each voice: volume, articulation and envelope. Entry is made on the 64 keyboard. It also has a jukebox function to make disks play like record albums.

Entech (10733 Chiquita, Studio City, CA 91604) has a snappy, updated version of their *Studio 64* music composition program ($39.95) which includes notes with ties, sharps and flats and several improved compositional features. Owners of previous versions may get an updated copy for $10 upon return of the original software. A $5.00 demonstration disk of *Studio 64* , "Knock Your Socks Off for Five Bucks", is now available. It includes ten sample songs (it's worth it just for the version of Michael Jackson's "Billie Jean") and a coupon for $5.00 off on a future purchase.

Add Mus'In , a new interrupt-driven machine language utility program from Entech, allows music composed with *Studio 64* to be quickly and easily added to another existing program. SYS commands in BASIC allow toggling (on/off) of several songs, as well as control of the tempo from within the new program.

Commodore composers will also be interested in Entech's Computer Song Writing Contest. One thousand dollars cash and free studio time will be awarded for the best musical composition written with *Studio 64* submitted by December 1, 1984. Independent music industry judges will determine the winner. Studio musicians, an arranger and producer will help turn it into a hit song! Contact Computer Song Writing Contest, P.O. Box 815, Sun Valley, CA 91353 or call (818) 768-6646 for more information.

There are so many delightful options now for making music with the 64 that whether you use the ASCII keyboard or one of the marvelous new musical keyboards to make note entry a pleasure, you're sure to have fun. And don't let a lack of formal training stop you—lots of professional musicians can't read music. Software for learning standard notation can take care of that, too, if you're so inclined. Music, the international language that speaks the dialect of emotion, can turn you and your 64 into a 20th Century one-man band par excellence! C

MusiCalc for the Commodore 64

One of the more universally acclaimed features of the 64 is its Sound Interface Device (SID). It provides, under software control, a wide range of functions associated with analog and digital sound synthesis systems.

By David R. Brooks

Programming the SID is a very challenging task because there are no direct sound-generating commands in Commodore BASIC. (It all has to be done with POKEs.) Although BASIC extensions that include some sound commands are now available, it's clear that language extensions will never be sufficient to exploit the full capabilities of this remarkable device.

A fundamental reason for this limitation is that a high-level interpreted language like BASIC is unsuited for providing dynamic real-time control over the SID's parameters. Control is required not just for pitch, duration and synchronization of notes, but also for filter settings, waveform and volume. As a result, effective SID music programs need to be written in machine language and must be sophisticated enough to allow real-time user interaction.

Several software vendors have responded to the need for professionally written programs to make the SID more accessible. In this article I'd like to examine one such product in detail.

MusiCalc

MusiCalc is produced by Waveform Corporation, 1912 Bonita Way, Berkeley, CA 94704. It consists of several program modules on 1541-compatible disks. There is no tape-based version. The modules I've accessed include: the synthesizer and sequencer *(MusiCalc 1)*, the scorewriter *(MusiCalc 2)*, the keyboard maker *(MusiCalc 3)*, the African/Latin Rhythm Template and the New Wave and Rock Template.

These modules are available in a professional package for $149.95. An advantage of this package price is that the two template disks are included at a reduced price with modules 1-3.

The *MusiCalc* series is intended to allow you to compose, transcribe, play, store and print music with the 64. The music can be your own, selections from a variety of preprogrammed music or a combination of the two.

I approached this software with a specific musical goal in mind: to teach the SID to play some three-part instrumental music by transcribing it from printed music into the computer. Of course, this is only one way to use *MusiCalc*, but it's a reasonable goal that can fully exercise the software capabilities. As I describe how I achieved my goal, I'll try to give you an understanding of *MusiCalc's* capabilities and, equally important, a feel for the musical personality this product projects.

The *MusiCalc* Synthesizer and Sequencer

The main *MusiCalc* module is the Synthesizer and Sequencer, called *MusiCalc 1*. It consists of an interactive machine language program and a series of preprogrammed musical sequences. The other modules work in conjunction with this one, either directly or as utilities for file creation and manipulation.

The first thing you'll notice when you start to work with the package is that the cables for connecting the 64 to an audio system or the speaker of a TV or monitor are not included. You have to buy or make them yourself.

A helpful accessory is the Sound Box from Human Engineered Software, 150 North Hill Drive, Brisbane, CA 94005. This interface allows you to connect video-out, audio-out and audio-in with the RCA phono pin plugs that are standard for home audio systems. You can also make your own cable from commonly available parts to connect directly to the 64's DIN plug. Be careful when hooking anything to your computer! Crossed wires or inappropriate signals applied to the connections can damage it. This is a good place to seek help if you feel unsure of your own skills.

Once you've made the proper connections, you can load *MusiCalc 1*. A digital clock is dis-

Illustrator: David Christiana

played on the screen during the loading process to let you know that things are happening. At the end of the load sequence the main screen display appears and a preselected musical sequence starts playing. This sequence represents the basic *MusiCalc* operating mode and lets you know that everything is working. (If you don't hear music, check all your audio connections!) The big moment has arrived. You're ready to become a computer musician!

Before discussing the *MusiCalc* sequences in more detail, let's take a look at the screen. The main display has two prominent features. The first is a number of slider controls and switches, effectively mimicking the kind of analog controls you might find on a real synthesizer. All the programmable SID parameters are represented on this single display: waveform settings, modulation and filter controls, oscillator synchronization and SID output volume. It's attractively designed, informative and a definite strong point of the *MusiCalc* system. Since some of the functions are color coded, it's helpful to have a color monitor. However, with a little practice, I got along fine with my monochrome monitor.

Second, the main screen also contains a grid of small boxes divided into 15 rows of 16 blocks each. This grid represents what *MusiCalc* calls a score. Each box in the score represents a time unit in a musical sequence. The active "time steps" at any instant are indicated by three colored squares, one for each of the SID voices.

You might think of the passage of a time step as one tick of the program's builtin metronome. However, there's an important difference: nothing happens in *MusiCalc* in less than one time step. As a result, the time step you choose for any score must represent the duration of the shortest note value in the score. For example, for music with a 4/4 time signature (four quarter notes to a measure), a piece having even one sixteenth note will require 16 time steps or one score row for each measure. At a moderate tempo of 120 quarter notes per minute, one *MusiCalc* score will last 30 seconds if only one voice is programmed.

If all SID voices are used simultaneously and none of the voices repeats itself in shorter sequences, one score will last ten seconds. There are 32 scores available at any given time. The time step and score concepts make it easy to synchronize even rhythmically complex parts in multivoice music by building up notes and rests from their shortest rhythmic units.

The *MusiCalc* manual states that up to 7680 notes can be stored and played back using the program. This is somewhat misleading. Actually, 7680 time steps are available (15 rows × 16 steps × 32 scores). This can represent 7680 notes only if there is always exactly one note per time step for each of the 32 scores.

An interesting feature on the SID allows you to filter and alter the volume of an external sound

signal and *MusiCalc* gives you control of this option. I haven't really made use of it, but I verified that it works by plugging in an external signal to the audio-in connection on the 64 DIN plug.

MusiCalc contains a set of 32 preprogrammed scores, called presets, which demonstrate a variety of musical and sound effects examples. Each preset has a voice setting, created by setting each slider control and switch on the main screen display. Although it seems clear that each of the preset scores is intended for use with the voice setting of the same number, you can choose the preset scores and voice settings independently by selecting the appropriate operating mode from the *MusiCalc* menu. This menu is easily accessible from the main screen.

In "working" mode, the current preset sequence plays over and over again even when you're doing other things like using the menu. This means that you can immediately hear the results of changing the voice settings while a score is playing. You can modify any of the 32 voice settings that go with the 32 preset scores or you can create entirely new voices as the sequence plays. I found this an excellent and enjoyable way to learn a lot about the SID's capabilities. You can experiment with the different basic waveform settings (triangle, pulse or sawtooth) and you can almost as easily get a feeling for some of the more unusual effects like filtering, voice synchronization and ring modulation. The *MusiCalc* manual could be more helpful in explaining how to utilize some of these effects; however, it's so easy to try various settings yourself that this is not much of a problem.

There is one significant restriction on SID sound, however. Because events are identified only with a particular time step, notes that have been released do not carry over to the next time step. In other words, playing notes on *MusiCalc* is very much like pressing and releasing an organ key. The sounds of a guitar or piano, which are characterized by a gradual decrease in volume as each note dies away, cannot be produced. The same restriction applies to attack times (the time for the volume of a note to rise from zero to its loudest level).

Whether this restriction is a problem depends on your own needs. I find myself missing a natural release on certain kinds of sounds; not everything is supposed to cut off like an organ! However you feel about it, this is definitely a part of the *MusiCalc* personality, to be traded off against the ease with which multiple parts can be synchronized with the time step concept.

Within its own boundaries, the range of available sounds from *MusiCalc* is very large, especially when more than one SID waveform plays in unison. In some cases, using voices in unison can fatten the sound or produce more realistic imitations of natural instruments. By proper timing of the voices, you can produce interesting echo effects. A strong point of *MusiCalc* is that these effects, which are very difficult or impossible to program from BASIC, are all readily and instantly available from the main *MusiCalc* screen.

Creating Music with *MusiCalc*

Let's turn now to another class of *MusiCalc* operations, creating your own musical sequences. This can be done from the *MusiCalc* screen by changing the voice settings or from the main menu in a series of operations that redefine the parameters of any given score and allow you to program blank scores or overwrite the preprogrammed preset scores. Of course, the presets still exist in unaltered form in the data file from which they were originally loaded into memory, so you haven't lost them.

These score-redefinition options allow you to do such things as create repeating sequences of notes, erase one or more voices or define the beginning location of voices within the score. Once you've set the score pattern you're ready to enter your own music into the score. You can do this through the keyboard mode or with a manual music entry system. In the keyboard mode, you can simply play along with other voices in a score using computer keys as your keyboard or you can change what's already in the score. And you can actually record what you're doing.

Personally, I don't find the keyboard mode very useful. For someone used to real keyboard instruments, computer keys are very awkward to use for this purpose. More fundamentally, the time step concept is at odds with the idea of a play-along keyboard which should operate as a real-time device. For example, if you press a key in the middle of a time step, nothing happens until the start of the next step.

Although *MusiCalc* isn't stridently advertised as live performance software, there is an implication that this is possible in the keyboard mode. There's an interesting music sample on the demonstration tape I received that's supposed to be done in the play-along mode, but I'm personally suspicious about the extent to which this sample can be extrapolated to performing situations. [Ed. Note: Waveform confirms that this sample was created in real time with only a 64 and a microphone and can be demonstrated live.]

The alternate music entry scheme involves entering notes into a *MusiCalc* score one time step at a time. The program doesn't use conventional music notation, so there are no music staffs or printed notes in the entry system. Using the function keys, you specify the octave and pitch of a note for one row of the score at a time. This might sound awkward, but it's not. The screen display is fine for this purpose and I prefer it to cuter, more representational systems that might actually be more time-consuming to use. With a little practice you can read the *MusiCalc* notation just as easily as conventional notation.

Notes that are longer than one time step are created by duplicating the note for the required number of time steps and latching the sound envelopes together. (This is also the way to produce a smooth (legato) sound from one note to the next.) Notes are easily latched or unlatched with one keystroke. However, inclusion of a one-key note duplicator to speed up creation of long note values would have been useful.

With *MusiCalc*, the score you're working with plays continuously as you create it. This might seem a bit monotonous after a while, but before you switch off your amplifier, consider that it's really very useful to hear immediately the results of what you're doing. I found myself choosing an unobtrusive voice setting during music entry, just to make sure I was putting in the right notes. It was easy to revoice the score later.

Saving and Manipulating Scores

Having created your own masterpiece, of course you'll want to save it. This brings us to the third important *MusiCalc* function: score saving and linking. The menu allows you to save a set of presets, including those you've created yourself, as a disk file under a name you select.

So far, so good. Recall, however, that one *MusiCalc* score doesn't represent very much music. I think most *MusiCalc* users will want to link several scores together; let's call the result a song. You can play a song from the main *MusiCalc* screen just by manually shifting from one score to another at the proper moment, but this requires some coordination!

The program for creating songs by linking together several scores (or parts of scores) for automatic playback under *MusiCalc* control is on *MusiCalc 2*, the ScoreWriter module, under the name List Maker. It's easy to use even though there are no specific instructions in the manual. Using this module, you create a list of scores and sound settings which you then save as a disk file for later use by *MusiCalc 1*.

I have to say that the program for playing back a song file created by List Maker (E.SEQUENCER) didn't work on my (production) version of *MusiCalc* . The problem seemed to be that an auxiliary program had to be read from the disk. The data files then had to be read from my own disk. Since there were no provisions for disk swapping when the program ran, the program crashed no matter which disk I had in place.

Waveform says that this has been corrected on the disks now being shipped. They also note that some earlier versions of the disk have a file called E.SEQ, which is a corrected version of E.SEQUENCER and should be used instead of E.SEQUENCER.

For owners of the original version I offer three solutions. First, you can alter E.SEQUENCER to provide the necessary break for disk swapping. Save this altered program on your own disk. (You still need the original *MusiCalc 2* disk because the BASIC program needs a machine language program (SEQ) that can't be transferred with a BASIC SAVE.)

The second solution, the one I chose, is to copy both E.SEQUENCER and SEQ onto your data disks. (These programs are not copy-protected.) This solution eliminates one disk swap when you're playing a song. Transfer of the machine language program (SEQ) requires a file copying utility suitable for this purpose.

Copying E.SEQUENCER and SEQ onto your data files might not be a bad idea even if you choose my third solution: write to Waveform and request the updated version of your *MusiCalc* disks and manuals.

After I straightened out the song-playing programs on my own disk, they worked fine. Note that the main screen is blanked out during playback. I expect this is done to minimize the number of things the computer has to do besides link the scores together and play the music. Assuming that such a trade-off is necessary, I have no complaints about this particular choice. It's interesting to note that there is an option within the program to blank out the screen when a single score is playing, for the stated purpose of getting the best possible voice synchronization. I suspect the song sequencing programs are doing the best they can with the available 64 resources.

In any event, the result of screen blanking is that you can no longer exercise real-time control over the voice settings. For exam-

ple, you can't change the time step length, as you might want to do to produce a gradual slowing down (ritard) at the end of a song. You can, of course, program a ritard into the score when you create it, but only in increments of the time step. The demonstration tape contains several examples of real-time control of filter and modulation parameters while single scores are playing. But you won't be able to reproduce this during playback of linked scores.

An interesting part of the *MusiCalc* concept is the inclusion of several auxiliary BASIC programs. (The programs I mentioned above for creating and playing songs are among these.) They not only handle utility functions like saving and retrieving files, but also allow you to manipulate your score files in a number of ways. You can save some of these programs on your data file disks to minimize disk swapping.

Unfortunately, the quality of these utilities is variable and their documentation is poor or nonexistent. My biggest complaint is the clumsiness of the disk handling. For example, it's too easy to cause these programs to crash if you make the mistake of having the wrong disk in the drive. (It's not always clear which disk is supposed to be there!) The frustration of disk operations with the relatively slow 1541 disk drive isn't Waveform's fault, of course, but it's imperative that professionally written software use good programming practices and adequate error trapping to minimize problems with disk operations.

On the plus side, Waveform seems to have a knack for balancing out the program's weaknesses with really good ideas. For the disk handling problems, Waveform has saved the day by keeping the main program and its data files in a part of memory not affected by the BASIC auxiliary programs. If one of the BASIC programs crashes, you can load and run the BASIC program CTRL and get back to *MusiCalc* without damaging any of your score files. (Breathe a sigh of relief!) I mention it because this capability is not noted anywhere in the manual and because it requires a certain amount of self-confidence for BASIC programmers to load a new program over one that's just crashed. If you're used to dealing just with BASIC programs, you know that a BASIC LOAD operation will erase the existing program. This is not true for *MusiCalc;* everything in the main program will remain intact.

Hopefully, Waveform will provide better disk handling and more complete documentation in the future. Once you figure out how to use these programs and get used to implementing them, they're really very useful. They have many capabilities I just don't have space to mention here. Let's just say that if there's something you'd like to do with your scores, there's probably a way to do it from within *MusiCalc* . Waveform has even included a couple of samples that show you how to write your own auxiliary programs to operate from within the main program. I haven't tried it yet, but it seems to be a welcome form of user friendliness.

The Keyboard Maker allows you to define four rows of keys on your 64 to play whatever notes you choose. There are 70 different scales to choose from, ranging from Pythagorean tuning to blues to rock.

More *MusiCalc* Capabilities

I haven't meant to neglect the other parts of the *MusiCalc* software. *MusiCalc 2*, the ScoreWriter, converts scores into conventional musical notation. It's intended to use the graphics capabilities specifically of a Commodore printer, and may or may not work with a non-Commodore printer, even if that printer is advertised as being interchangeable with Commodore printers.

ScoreWriter seems to work as intended. There was no documentation at all with my review package, but the program is largely self-documented. It transcribes your scores very literally and not always exactly as you expect. The score transcription quirks result partly from the time step concept and partly from the very nature of the program. For example, if you have a quarter note that occupies four time steps, you might make it staccato by having it last only one or two time steps and filling the remaining steps with rests. ScoreWriter doesn't know about staccato notes, so it writes a sixteenth or eighth note followed by the appropriate number of rests. This is accurate but not conventional and is probably not the way a person would do it. However, the interpretation of music in terms of a score is still a problem for computers and Waveform's solution seems to me to be a good one under the circumstances.

The third part of the package, *MusiCalc 3*, the Keyboard Maker, allows you to define four rows of keys on your 64 to play whatever notes you choose. There are 70 different scales to choose from, ranging from Pythagorean tuning to blues to rock. Again, although there was no documentation included with my package, the program seemed easy enough to use. A similar capability is available directly from *MusiCalc 1* when it operates in the keyboard mode. The main differences are that in the *MusiCalc 1* keyboard mode the keys are already defined (in a perfectly logical way, I should add) and there are fewer scales to choose from.

There seem to be many possibilities for using the Keyboard Maker for educational purposes. Not surprisingly, Waveform is developing such an interface. Presumably, these keys could be defined with Keyboard Maker just

as the 64 keyboard can.

Finally, there are the templates included in the professional package. They consist of preset files to be loaded from within *MusiCalc*. (Like the other modules, the templates work only with *MusiCalc 1*.) I was most interested in these as a source of ideas for controlling the SID voices. In principle, you can use them as accompaniments to musical lines you play yourself in keyboard mode. I suggest you listen to these templates before you buy them separately, to make sure you'll be able to use them.

There's one more *MusiCalc* program I want to mention. Tucked quietly away on the *MusiCalc 2* disk is a program called E.SYNC. It is undocumented in the manual, but it contains a lengthy descriptive help file that can be called from within the program. It allows you to drive another device with the clock pulse generated by *MusiCalc* and the 64 or replace the internally generated pulse by an external one. This is the foundation for a whole new world of multitrack sound and music synthesis. Using it, you can use *MusiCalc* to drive a rhythm synthesizer or the other way around. In principle, you could use one 64 to drive another one that was also running a *MusiCalc* program. With the proper software and hardware interfaces, you could connect your 64 to a wide range of analog and digital synthesis equipment. I know Waveform is working on many of these possibilities. The more adventurous among *MusiCalc* users might want to try some things on their own using E.SYNC as a starting point. [Waveform points out that any peripheral run by *MusiCalc* must be completely TTL compatible. Some devices that claim to be TTL compatible are only partially so, and will not work.]

There's one final topic I'd like to discuss in conjunction with the package. I was interested to see that the manual recommends use of equalization and reverb (time delay) with this software. Waveform uses both on their demonstration tape. (It's to their credit that they state this quite plainly at the beginning of the tape.) The processing is intended to fatten the SID sound and take away some of the dryness associated with electronically-generated music. To these processors I would add a noise gate, a device which senses signal levels and cuts everything off when the signal drops below a predetermined value. This would minimize interference from the noise that occasionally plagues the SID chips. It's worth noting that the need for signal processing has nothing to do with the *MusiCalc* software per se; it's simply a normal part of electronic music synthesis in general.

Suitable signal processing will go a long way toward filling out and cleaning up SID sound. Besides the large variety of such equipment available from your local musical equipment store, there is some relatively inexpensive audio signal-processing equipment in kit form that's worth looking at. PAIA Electronics, 1020 W. Wilshire Blvd., Oklahoma City, OK 73116, makes a wide range of music synthesis and signal processing hardware, including all the devices mentioned above. Another source of sound processing modules in kit form is Rodcar Electronic Sales, 9983 Monroe, Dallas, TX 75220.

Catalogs from these two companies are required reading for those thinking about building their own music synthesis equipment. *Electronic Projects for Musicians*, by Craig Anderton, contains a number of interesting circuits. This book, and kits for many of its projects, are also available from PAIA Electronics.

Conclusions

I believe that one good overall test of software is whether or not it continues to hold your interest after you become familiar with it. *MusiCalc* certainly passed that test. In the process of learning how to use it, I succeeded in my goal of recording some three-part music. In terms of the time and attention required and the insight it provided, I found it to be similar to rehearsing music for performance on instruments.

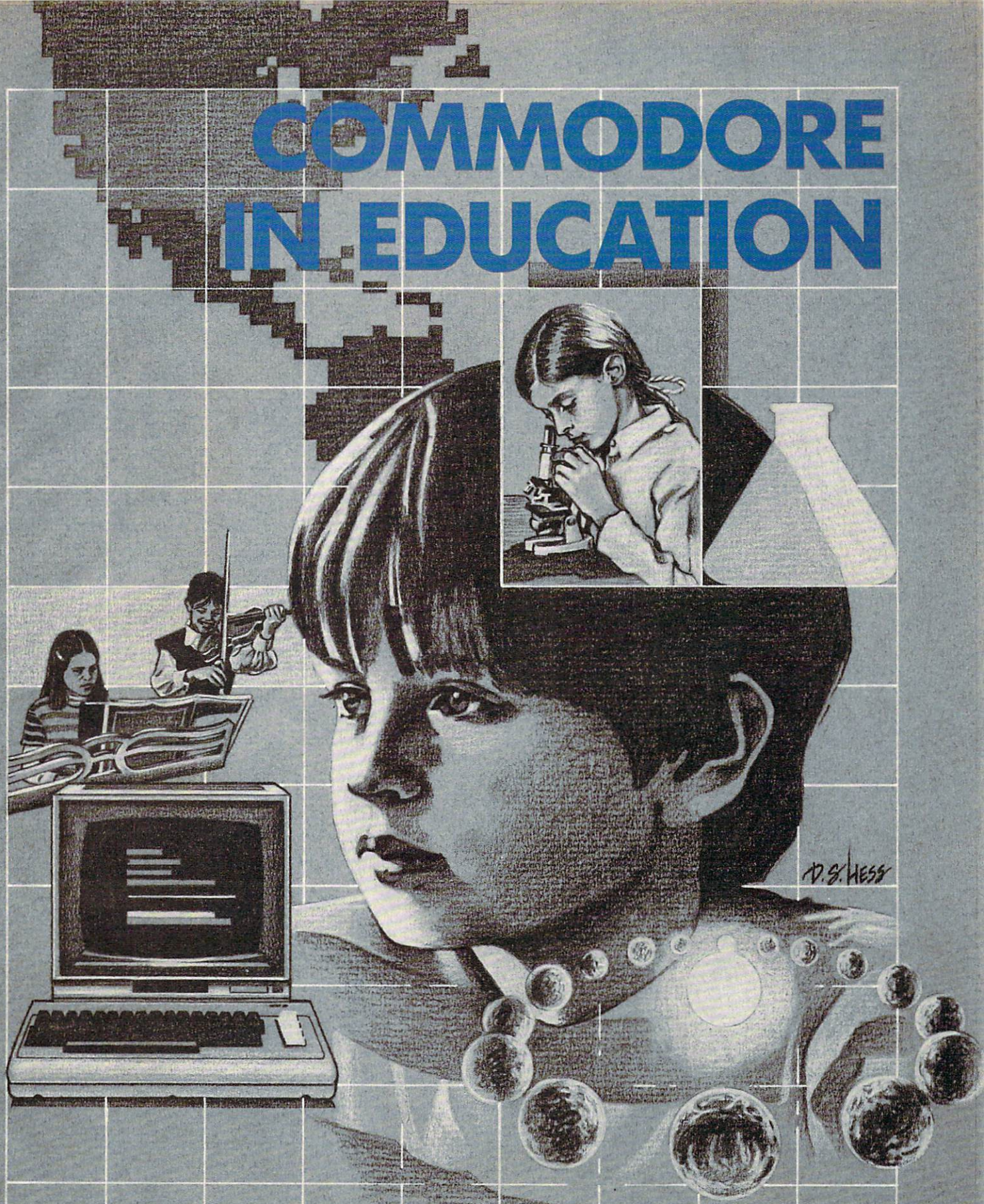
The program provides a different way of looking at and preserving music. The result has a permanence that live performance does not, and yet the retained potential for significant change gives it a flexibility that analog recordings lack. If you're motivated to explore the possibilities of SID music, *MusiCalc* offers lots of maneuvering room and satisfaction as a musical tool.

It seems clear that Waveform will continue to expand *MusiCalc* capabilities in the future. As it stands now, constructive use of *MusiCalc* requires some familiarity with the concepts of music synthesis and more computer skills than it ought to. I'm optimistic that by the time you read this, the programs will be a lot easier to use.

The problems I've noted in this review are relatively minor compared to the strengths of the software. However, these problems are real and highly visible evidence of the intense pressure to market computer-related products before they're thoroughly tested. I'm pleased to say that Waveform has taken the time to be consistently responsive to my many queries about *MusiCalc*, frank about acknowledging problems and apparently determined to improve the programming and documentation. The fact that some of the utility programs are not as cleanly written as they ought to be should not overshadow the fact that Waveform has produced an extremely interesting, very flexible and powerful music package.

One of the most interesting parts of writing this review has been realizing the extent to which an overall programming concept like the *MusiCalc* time step has formed a musical personality for the SID. It seems inevitable that other approaches, with which I'm much less familiar, will impose their own personalities, too. So my advice is, look at the options relative to your own needs. C

COMMODORE IN EDUCATION



A Tool For Today's Students

Subject-Oriented Educational Software for the Commodore 64

Compiled by Commodore Education Specialists

(Each month, Commodore's educational SIG on CompuServe will have a listing of new software available for the Commodore 64.)

ALGEBRA TRIGONOMETRY AND CALCULUS

Algebra Arcade *(grades 7-12)*
WADSWORTH ELECTRONIC PUBLISHING
(Entering an algebraic equation creates a whirlwind that knocks down "algebroids" as it forms the graph)

Algebra Gamut *(grade 9)*
MICROGRAMS
(Practice with basic algebraic equations dealing with binomials, trinomials, radicals, exponents rational expressions and polynomials)

Algebra Gauge *(grade 9)*
MICROGRAMS
(Working for points solving simple equations)

Algebraic Laws *(grade 9)*
MICROGRAMS
(Use of properties of operations; identify, commutative, associative, distributive, zero and inverse)

Algebra Series: Simultaneous Linear Equations
(grade 9 and above)
MICROCOMPUTER WORKSHOPS CORPORATION
(Random linear equations are generated that are solvable by addition or subtraction)

Algebra I Volume One
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing—on-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Algebra I Volume Two
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing—on-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Algebra II Volume One
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing—ongoing testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Algebra II Volume Two
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing—ongoing testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Algebra III Volume One
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing—ongoing testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Algebra IV Volume Two
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing—ongoing testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Linear Equations *(grades 7-11)*
Quadratic Equations
(grades 9-12)
CBS SOFTWARE
(Two separate programs that emphasize and reinforce an understanding of algebraic principles and basic operations used in the solving of linear equations and the factoring and solving of quadratic equations. The error analysis differentiates between mistakes made in procedure and errors made in computation)

Algebraic Expressions Rewriting Verbal Phrases as Algebraic Expressions
(grades 7-12)
EDUCATIONAL ACTIVITIES
(This program clearly explains the way in which verbal phrases correspond to algebraic expressions as the computer reviews addition, subtraction, multiplication and division. It also explains the use of the comma)

Algebraic Expressions Evaluating Algebraic Expressions *(grades 7-12)*
EDUCATIONAL ACTIVITIES
(Clear, step-by-step instructive examples show how the basic variables X and Y function in algebraic expressions. Tutorial exercises teach the evaluation process)

Equation—Solving Equations Level I *(grades 7-12)*
EDUCATIONAL ACTIVITIES
(This program provides random equations of one variable and one operation)

Equations—Solving Equations Level II *(grades 7-12)*
EDUCATIONAL ACTIVITIES
(This program provides random equations of one variable and two operations and frequent use of parentheses)

Equations—Solving Equations Level III *(grades 7-12)*
EDUCATIONAL ACTIVITIES
(This program provides random equations which include the variable on both sides)

Factoring Trinomials
(grades 8-12)
JMH
(Three levels of difficulty for practice in factoring trinomials)

Factoring Perfect Sq. Trinomials *(grades 8-12)*
JMH
(Three levels of difficulty in factoring perfect square trinomials)

Factoring the Difference of SQ
(grades 8-12)
JMH
(Various levels of difficulty in tutorial form with help using multiple choice; fill in; and give the factors)

Factoring Trinomials with Common Monomial Factors
(grades 8-12)
JMH
(Several levels of help are provided and a student summary of progress is provided)

Graphing—Introduction to Graphing on the Coordinate Points on the Coordinate Plane
(grades 7-12)
EDUCATIONAL ACTIVITIES
(This program provides instruction on writing an ordered pair for a point displayed on a graph. Random points are displayed on a Coordinate Plane allowing the student to input the correct X and Y coordinates for each)

Graphing Exponential Functions *(grades 7-12)*
EDUCATIONAL ACTIVITIES
(The combination of tutorial and drill provides a very effective approach which allows the student to master calculating exponents and graphing linear functions)

High School Math
(grades 9 & above)
SETZER EDUCATIONAL SERVICES
(119 programs covering algebra, geometry, trigonometry, logic, probability and statistics)

Master Math *(grades 9 & above)*
PMI
(A six part program covering logarithms, antilogarithms, division by numbers with decimal parts and approximation by rounding, algebra, trigonometry and calculus)

ARITHMETIC

Add *(grades 1-4)*
COMM DATA COMPUTER
(A graphic demonstration of the addition process)

Addition Magician *(grades 1-5)*
THE LEARNING COMPANY
(A strategy game for learning basic addition skills)

Addition With Carry *(grades 2-5)*
MICROCOMPUTER WORKSHOP
(Randomly generates problems up to nine rows and nine columns, and notes errors)

Add/Sub *(preschool-grade 2)*
BOSTON EDUCATIONAL COMPUTING
(Addition and subtraction programs for beginners with various levels of difficulty)

Archer *(grades 3-5)*
MICROGRAMS
(Addition and subtraction problems of two and three digit numbers in a game format)

Add Facts 0-5 *(grades 1-6)*
JMH
(Two types of timed practice for addition facts 0-5)

Add Facts 0-10 *(grades 1-3)*
JMH
(Timed practice with sums ranging from 0 to 10)

Add Facts 0-20 *(grades 1-3)*
JMH
(Timed drill with addition problems for sums 0-20)

Add It *(grades 1-3)*
COMM DATA COMPUTER
(Large graphic numbers from a 1-, 2- or 3-digit addition problem)

Addition and Subtraction
(grades 1-3)
RIGHT ON PROGRAMS
(Teaches basic addition and subtraction with drill)

Adding Blocks *(grades 1-3)*
JMH
(Practice in addition problems with the use of shapes)

Addition Concept *(grades 1-3)*
JMH
(Adds cars to the train engine and sends it on its way by answering problems in beginning)

Addition Table *(grades 1-3)*
JMH
(Practice in addition of numbers 1 through 9, with sums ranging from 2 to 18)

Agent Blotto *(grades 1-3)*
JMH
(This program uses math questions to solve a mystery)

Base Conversion *(grades 9 & above)*
MICROGRAMS
(This program teaches base ten conversion to binary and hexidecimal)

Basic Math Skill
(grades 6 & above)
SETZER EDUCATIONAL SERVICES
(Twenty-one programs covering basic math competencies)

Basic Math Skill Series *(grades 3 and above)*
H. C. WARD
(A series of 24 remedial math programs)

Before-After *(grades k-2)*
COMPUTER COURSEWARE COMPANY
(Student picks number before and after as well as second option where student picks number in between)

Coins *(grades 1 and above)*
SCHOOL HOME AND COURSEWARE
(Students learn to make change with coins)

Commodore Plus Curriculum
(grades k-6)
DATA COMMAND
(A total of 46 programs cover basic match skills at the elementary level. Teacher materials provide learning objectives.)

Derby *(grades 4-6)*
MICROGRAMS
(Addition, subtraction, multiplication and division problems are solved to race horses)

Expand/Compress Value
(grades 1-6)
COMPUTER COURSEWARE
(Students expand and compress numbers or give values to the digits)

Fast Facts *(grades 3-5)*
MICROGRAMS
(Practice in times tables)

Fay: That Math Woman
(grades 1-4)
DIDATECH SOFTWARE
(Graphics are used to teach basic skills on a number line)

Fundamentals of Mathematics
(grades 3 and above)
STERLING SWIFT
(Covers basic math operations in tutorial format with drill and practice. Includes supplementary student and teacher materials.)

Ginger the Cat Adds and Subtracts *(pre-school—grade 1)*
CARDINAL
(Adding numbers between 0 and 9)

How to Divide *(grades 3-6)*
COMPUTER COURSEWARE
(Teaches long division in a tutorial format)

Less-More *(grades 1-3)*
COMPUTER COURSEWARE
(Program chooses a number and student must select the number before and after)

Lowest Common Multiple
(grades 3-8)
COMPUTER COURSEWARE
(Student selects lowest common multiple)

Math Invasion Games
(grades 3-9)
SETZER EDUCATIONAL SERVICES
(Ten arcade style games covering basic operations)

MicroAddition *(grades k-5)*
HAYDEN SOFTWARE CO.
(Basic addition and counting of whole numbers)

MicroDivision *(grades k-5)*
HAYDEN SOFTWARE CO.
(Graphics and music are used to teach division)

MicroSubtraction *(grades k-5)*
HAYDEN SOFTWARE CO.
(Drill in two digit subtraction problems)

Missing Number *(grades k-2)*
COMPUTER COURSEWARE
(Students must enter missing numbers in a sequence)

Monkeymath *(grades k-5)*
ARTWORX SOFTWARE
(Provides levels of difficulty for addition, subtraction, division and multiplication in a game format)

Multi-BECI *(grades 3 and above)*
BOSTON EDUCATIONAL COMPUTING
(A multiplication program with up to three digit multipliers)

Number Line *(grades 1-3)*
COMPUTER COURSEWARE
(Computer chooses numbers and the student must arrange them in the correct order)

Odd-Even *(grades k-1)*
COMPUTER COURSEWARE
(Student must identify randomly generated numbers as odd or even)

One to Nine *(grades 3-8)*
COMPUTER COURSEWARE
(Student adds a series of numbers by choosing the correct answer)

The Pet Professor *(grades 3-8)*
COW BAY COMPUTING
(77 programs in fractions, decimals, addition, subtraction, multiplication and division)

Prime Numbers *(grades 4-8)*
COMPUTER COURSEWARE
(Student must identify prime numbers)

Race Car 'Rithmetic *(grades 1 and above)*
UNICORN SOFTWARE
(User selects a math operation, level of difficulty and rate)

Right to Left *(grades 1-3)*
COMPUTER COURSEWARE
(Student answers simple math problems by digit from left to right)

Rounding *(grades 3-6)*
COMPUTER COURSEWARE
(Students round random numbers to the specific place)

Scientific Notation *(grades 6 and above)*
SCHOOL AND HOME COURSEWARE
(Drill on translating between standard notation and scientific notation with selectable levels of difficulty)

Ships Ahoy *(grades k-6)*
UNICORN SOFTWARE
(User selects difficulty level and rate for addition, subtraction, multiplication and division)

Shooting Gallery *(grades 3-5)*
MICROGRAMS
(Game format provides for basic drill in addition and subtraction)

Small-Large Sets *(grades 3-6)*
COMPUTER COURSEWARE
(Student matches set for greater than, less than or equivalent to)

Story Problems Practice *(grades 5-8)*
MICROGRAMS
(Problems that are randomly generated covering addition, subtraction, multiplication and division)

Mathfinder *(grades K-6)*
HOLT, REINHART & WINSTON
(Programs that provide tutorial and drill and practice for Holt Mathematics 1981 Basic Math Textbook Series)

Mathfinder *(grades K-6)*
HOLT, REINHART & WINSTON
(Programs that provide tutorial and drill and practice for use with MacMillan Mathematics Basic Textbook Series, 1982)

Mathfinder *(grades K-6)*
HOLT, REINHART & WINSTON
(Programs that provide tutorial and drill and practice for use with Heath Mathematics Textbook Series, 1983)

Mathfinder *(grades K-6)*
HOLT, REINHART & WINSTON
(Programs that provide tutorial and drill and practice for use with Scott Foresman Mathematics Textbook Series, 1980/1983)

Mathfinder *(grades K-6)*
HOLT, REINHART & WINSTON
(Programs that provide tutorial and drill and practice for use with Mathematics In Our World Basic Textbook Series, 1981/1983)

Mathfinder *(grades 1-6)*
DESIGNWARE
(Multiple skill levels provide practice in addition, subtraction, multiplication and division. Includes 40 prepared mazes. User can also make their own to use with the game)

Alexander The Great *(grades 4 and above)*
KRELL SOFTWARE CORP.
(Game for developing word and arithmetic skills)

Astro-Grover *(preschool-grade 2)*
CBS SOFTWARE
(Offers children experience with the early math concepts of counting, addition and subtraction)

Big Bird's Funhouse *(preschool to kindergarten)*
CBS SOFTWARE
(Offers children experience with important skills including auditory and visual matching and counting)

Ernie's Magic Shapes *(preschool-grade 1)*
CBS SOFTWARE
(Match shapes, identify colors, structure parts into meaningful wholes, recognize figures embedded in other figures and distinguish similarities and differences. On-screen instructions plus six skill levels)

Big Bird's Special Delivery *(preschool-grade 1)*
CBS SOFTWARE
(Encourages the development of basic skills and provides a playful setting in which children can practice classifying objects. Child must consider and compare different objects according to their form, class and, on the highest level, function)

Sea Horse Hide'n Seek *(preschool-grade 1)*
CBS SOFTWARE
(Emphasizes a basic understanding of color and size relationships)

Ducks Ahoy! *(preschool-grade 1)*
CBS SOFTWARE
(Provides practice in predicting outcomes)

Math Mileage *(grades 4 and above)*
CBS SOFTWARE
(Users steer their formula race cars through the countryside along a twisting, fork-filled course, selecting the shortest route to a number goal. Quick thinking helps them develop their abilities to estimate and plan ahead, both logically and strategically, while solving math problems. And the exciting Night Driving option increases the challenge and provides practice in mental arithmetic. With multiple skill levels, up to four racers can take turns trying to achieve their own personal best. Colored flags and musical clues advise racers on progress and warn against hazards like multiplying by zero. After each race, a recap screen reviews scores, routes and times)

Addition and Subtraction *(grades 1-4)*
CBS SOFTWARE
(Provides drill and practice in addition with carrying and subtraction with or without borrowing. Emphasizes an understanding of place value. User may input difficulty level for each series of problems)

Multiplication and Division *(grades 2-8)*
CBS SOFTWARE
(Emphasizes an understanding of multiplication and long division and provides practice in the solving of problems utilizing necessary addition and subtraction. Users may choose between 2 or 3 digit multipliers and and 1, 2 or 3 digit divisors)

Compu-U-Solve—An Adventure in Problem Solving *(grades 7-12)*
EDUCATIONAL ACTIVITIES
(Comp-U-Solve Programs are simulations of classical puzzles that test and stretch the thinking capacity of your students as they try to solve the problem in the least possible moves)

Read and Solve Math Problems *(grades 4 and above)*
EDUCATIONAL ACTIVITIES
(Progressive tutorial and practice programs that teach your students the important elements of word problems to number problems. Programs are high interactive, provide reinforcement of all concepts and whenever necessary they branch to reteach)

Math Baseball *(grades 4 and above)*
EDUCATIONAL ACTIVITIES
(A baseball game format is used to motivate the student to do the repetitive drill and practice problems necessary to build addition, subtraction, multiplication and division skills)

Math Conqueror *(grades 4 and above)*
EDUCATIONAL ACTIVITIES
(This program presents arithmetic drills as a motivational and familiar game format. The computer places problems on the screen which move downward toward the student's spaceship. The student must move the spaceship under the problem and type the correct answer to shoot down the problem. This approach makes repetitive drill and practice work fun)

Basic Math Competency Skill Building *(grades 4 and above)*
EDUCATIONAL ACTIVITIES
(A comprehensive, interactive, tutorial and practice math program which makes full use of the computer's graphic, branching and interactive capabilities. The programs are versatile and can be used with all appropriate students regardless of age)

Long Division *(grades 7-12)*
EDUCATIONAL ACTIVITIES
(Using a tutorial and drill approach, this program teaches, practices, reviews and reinforces the learning of long division principles)

Percentages *(grades 7-12)*
EDUCATIONAL ACTIVITIES
(This series of programs provides both instruction and reinforcement in solving percent problems. The programs utilize both tutorial and drill formats to develop skill in percent conversion and computation)

Introduction to Mathematics on the Computer
EDUCATIONAL ACTIVITIES
(This program was designed to help slow learners and learning disabled students increase their mathematical abilities by decreasing the distractibility factor and increasing the student's interest. This program covers addition, subtraction, multiplication and division)

Missing Math Facts *(grades 3 and above)*
EDUCATIONAL ACTIVITIES
(This program contains addition, subtraction, multiplication and division examples on four levels of ascending difficulty. The student must figure out what the missing number is)

Math for Everyday Living *(grades 4-9)*
EDUCATIONAL ACTIVITIES
(Real-life math and business skills are taught with this progressive tutorial and practice program. Making full use of the randomizing and branching capabilities of the computer, the student is given choices to make in real-life simulation-type activities)

Quantitative Comparisons
PROGRAM DESIGN, INC.
(Eight programs that prepare students for SAT-type math problems. Problems start with elementary concepts and cover most material that would appear in the test)

Number Series
PROGRAM DESIGN, INC.
(1, 2, 4, 7, 11 . . . What's next? Learn how to approach number series problems and how to analyze their patterns)

Survival Math *(grades 6 and above)*
SUNBURST
(Four simulations help students apply math skills to everyday life)

Alien Addition *(grades 1-4)*
DLM
(Addition skills are drilled in arcade-game format at various levels of difficulty)

Minus Mission *(grades 1-4)*
DLM
(Subtraction skills are drilled in arcade-game format at various levels of difficulty)

Alligator Mix *(grades 1-4)*
DLM
(Arcade-game format increases skills in addition and subtraction)

Meteor Multiplication *(grades 3-6)*
DLM
(Multiplication skills are drilled in arcade-game format)

Chopper Math *(ages 7 and above)*
COMMODORE
(Practice basic math skills)

Number Nabber/Shape Grabber *(ages 6-12)*
COMMODORE
(Two learning games in one. Builds arithmetic and shape identify skills)

Golf Classic/Compubar *(ages 10-14)*
COMMODORE
(Golf Classic—Angle and length estimation. Play the angles, choose distances. Compubar—Read graphs, construct arithmetic expressions)

Frenzy/Flip Flop *(ages 6-14)*
COMMODORE
(Frenzy—Subtraction and division Flip Flop—Transformational geometry)

Gulp!/Arrow Graphics *(ages 6-12)*
COMMODORE
(Gulp—Addition and multiplication drill. Arrow Graphics—Problem solving and directionality)

Number Builder *(ages 8-13)*
COMMODORE
(Builds skills in addition, subtraction, multiplication and division)

Learning Tutor Math Series *(ages 9-12)*
COMMODORE
(Provides the child with on-screen instructions, an excellent step-by-step lesson and practice questions)

ARTS

Aural Skill Trainer *(grades 5-12)*
ELECTRONIC COURSEWARE SYSTEMS, INC.
(Developed to improve students' aural skills in the perception and identification of intervals, basic chords and seventh chords. Student record keeping included)

Clef Notes *(grades 5-12)*
ELECTRONIC COURSEWARE SYSTEMS, INC.
(Includes drill and practice on treble, alto, tenor and bass clef, and retains student achievement information)

Coco-Notes *(grades 3 & above)*
CBS SOFTWARE
(A playful, interactive musical activity in which players and the computer collaborate on musical compositions. Aided by the Jazz Scats on Coco-Note Isle, players catch notes, create melodies and fish for tunes)

Dancing Feats *(all grades)*
SOFTSYNC
(A program that plays rock, jazz or blues music, enables users to play and record their own songs; and displays notes and chords. The program provides a wide selection of beats, styles and endings)

Ear Challenger *(grades 5-12)*
ELECTRONIC COURSEWARE SYSTEMS, INC.
(An aural-visual game designed to increase tonal memory of a series of pitches played by the computer. The game includes seven levels of difficulty based upon the number of pitches presented. Each pitch is reinforced visually through a color presentation on the display screen)

Keyboard Drill *(grades 5-12)*
ELECTRONIC COURSEWARE SYSTEMS, INC.
(Designed to increase students' speed in identifying notes randomly placed on the bass and treble staves. The response time can be set to adjust the level of difficulty. The program presents the student with a summary score at the end of each session)

Key Signature Drill
(grades 5-12)
ELECTRONIC COURSEWARE SYSTEMS, INC.
(Designed to increase speed in identifying major and minor keys as presented on brass and treble staves. The drill can be timed with the limit set to adjust the difficulty level. A student summary score is presented at the end of each session)

Magic Voice Speech Module
COMMODORE
(Realistic voice synthesizer. Features include simultaneous voice and music generation, simultaneous voice graphic actions, and 235 words built-in with additional vocabulary available from optional cartridges or disks)

Music Construction Set
(grades 3 and above)
ELECTRONIC ARTS
(Allows users to construct and play multiple-voice music by manipulating on-screen pictures of notes, rests, clefs, accidentals and the like)

Note Name Drill *(grades 5-12)*
ELECTRONIC COURSEWARE SYSTEMS, INC.
(A music activity drill designed to increase students' ability to name notes in the treble and bass clefs. The drill can be timed with the limit set by the user. A summary score is presented upon completion of each session)

Halftime Battlin' Bands
(grades 4 and above)
CBS SOFTWARE
(Kids act as choreographers to stage their own Be-Bop Bowl halftime show, trying to slip up the opposing band while creating their own marching tunes and band formations)

Movie Musical Madness
(grades 4 and above)
CBS SOFTWARE
(Kids act as writer, composer and director on the set of their own Hollywood classic. Kids make their own movies, from casting and set design to editing and sound tracking.

The House That Jill Built
(all ages)
CBS SOFTWARE
(Anyone can build the house of his or her dreams with this delightful and rewarding computer workshop)

Music Composer
COMMODORE
(Create, play and save your tunes easily. Simulates up to 9 instruments. Notes appear on screen. Play your keyboard like a piano)

Music Machine
COMMODORE
(Play piano or organ melodies and percussion rhythms together. Music staff shows notes on screen. Vibrato, tempo and pitch controls)

Leo's 'Lectric Paintbrush
(all grades)
CHALK BOARD INC.
(When you use Leo's 'Lectric Paintbrush software, you are ready for magical, multi-colored electronic finger painting. Make your own pictures. Color them. Change them. Save them)

MicroMaestro *(all grades)*
CHALK BOARD INC.
(This software turns your PowerPad into a piano keyboard. Touch the keys. You hear the music and see your composition right on the screen. It is the fun way to learn music)

Dancing Bear *(all grades)*
KOALA TECHNOLOGIES CORP.
(This program lets you choose from a variety of sound and motion options to stage your own cabaret-style musical)

Spider Eater *(all grades)*
KOALA TECHNOLOGIES CORP.
(Teaches kids note recognition, meter and composition as they chase elusive little spiders scurrying home to their webs. It's the perfect game for musical education and teaching computer fundamentals as well)

Coloring Series I *(all grades)*
KOALA TECHNOLOGIES CORP.
(Coloring Series I is a computer coloring book that allows you to transform designs into an infinite number of creative variations with your Koala Painter. It's a whole world of colorful; geometric designs and bright new images that you create yourself)

Paint-A-Rhyme *(preschool to grade 3)*
KOALA TECHNOLOGIES CORP.
(Children can create and color their own free-hand drawings while they learn the words and music to their favorite nursery rhymes. They can also color predrawn illustrations of each rhyme)

Songwriter *(all grades)*
SCARBOROUGH SYSTEMS, INC.
(This program allows students to compose music at the computer while learning the fundamentals of music and theory. At the touch of a key, the tempo can be adjusted and a note positioned higher or lower on the scale, or the note can be erased)

BUSINESS EDUCATION

Accounting Tutor *(college)*
THE WIZARD
(Covers basic accounting concepts)

Automated Accounting For The Microcomputer
(grades 10 and above)
SOUTH-WESTERN PUBLISHING COMPANY
(Program covers the four major components of general ledger, accounts payable, accounts receivable and payroll)

Baron: The Real-Estate Market Simulation *(grades 10 and above)*
BLUE CHIP SOFTWARE
(Simulation for learning about investments in real estate)

Farm Life *(grade 1)*
RIGHT ON PROGRAMS
(Teaches student about farm animals and farm products)

How To Make Good Investments *(college)*
THE WIZARD
(Teaches the fundamentals of stock market and real estate investment analysis)

Lemonade *(grades 7 and above)*
PUBLIC DOMAIN COMMODORE
(Student operates a lemonade stand for 10 weeks, taking into account, price, quantity and other variables.)

MasterType *(grades 2 and above)*
SCARBOROUGH SYSTEMS
(Teaches beginning through advanced typing)

Millionaire:The Stock Market Simulation *(grades 10 and above)*
BLUE CHIP SOFTWARE
(A simulation which teaches the intracacies of investment in the stock market)

Type Right *(grades 4 and above)*
COMMODORE
(Contains 17 lessons and 5 games that teach the basics of typing)

Typing Strategy
(grades 2 and above)
BEHAVIORAL ENGINEERING
(Teaches typing, games and exercises included)

Typing Tutor/Word Invaders
(grades 3 and above)
ACADEMY SOFTWARE
(Teaches typing with four basic levels. Game part Word Invaders is matched to ability level)

CLASSROOM MANAGEMENT

EA Gradebook *(all grades)*
EDUCATIONAL ACTIVITIES
(This program keeps percentage grades for as many as 20 classes of 36 students with 36 test or assignment scores for each student. It is expandable to accommodate more students or more assignments simply by pressing a key indicated by the computer)

ECS Computerized Gradebook
(all grades)
ELECTRONIC COURSEWARE SYSTEMS
(Keeps up to 50 names with ten scores each)

Grader *(all grades)*
MICROGRAMS
(Averages grades by typing in a series of letter grades and provides a numerical equivalent and a letter grade average)

Gradebook *(all grades)*
EDUCATIONAL SOFTWARE ASSOCIATES
(A complete class gradebook program)

GradeCalc *(all grades)*
TAMARACK SOFTWARE
(Keeps records on attendance and grades for a class)

Master Grades *(all grades)*
MIDWEST SOFTWARE
(Designed primarily for secondary teachers; it can also be used at the elementary and college levels. The program will hold 200 names, also includes summaries for students and three types of progress reports for parents)

The Manager *(all grades)*
COMMODORE
(Full data base management program specifications include; 1500 character record, 2000 records per file, 250 fields per record, sorting on 16 keys 20 data entry screens per file, indexing on any field, report generator arithmetic calculations, boolean searches and link to Easy Script word processor)

Mini Jini Record Keeper
(all grades)
JINI MICRO-SYSTEMS
(General data base which can be used to alphabetize, record grades, change records)

Test Tabulator *(all grades)*
MICROGRAMS
(Teacher types in the answer key for true-false, multiple choice, or matching test questions. Program is designed to accommodate up to 40 test questions for 35 students)

COMPUTER LITERACY AUTHORING LANGUAGES

Assembler 64
COMMODORE
(For experienced assembly language programmers. Create, assemble, load and execute 6500 series Assembly language code. Macro assembler. Two machine language monitors. Editor and loader. Support routines)

BLT *(grades 4 and above)*
MICROGRAMS
(Beginning concepts for BASIC programming)

Clas *(all grades)*
TOUCH TECHNOLOGIES, INC.
(Computerized lesson-authoring system designed to help educators create their own courses)

Commodore 64 Comal
COMAL USERS GROUP
(An advanced easy to use programming language designed to replace BASIC)

Computer Crossword
(grades 5 and above)
MICROGRAMS
(Students can test their knowledge of computer terminology)

Computer Literacy: An Introductory Course
(grades 6-8)
THE CONTINENTAL PRESS
(Introduces computers through the use of 15 lessons. Supplementary materials include workbooks and transparencies)

Computer Literacy Instructional Program (CLIP)
EDUCATIONAL ACTIVITIES
(Step-by-step self-paced format provides the users with hands-on experiences using drill and practice, tutorials, simulation, testing and evaluation on the microcomputer.

D-BUG *(grades 3-6)*
ELECTRONIC ARTS
(Teaches how computers are designed and by fixing one when it breaks down)

Debugger Pro Series
(grades 5 and above)
MICROGRAMS
(Students debug actual programs)

The Do It Yourself! Book
(grades 7 and above)
SOFTRON
(Tutorials on how to program games)

Early Childhood Learning Program *(preschool to grade 3)*
EDUCATIONAL ACTIVITIES
(Allows young children to acquire cognitive skills)

Eliza *(grades 4 and above)*
ARTIFICIAL INTELLIGENCE RESEARCH GROUP
(Analyses user input and responds with appropriate statements)

Exploring Logo *(grades 6-9)*
SUNBURST COMMUNICATIONS
(Activity cards for use with teaching LOGO)

How to Program In Basic
(grades 6 and above)
STERLING SWIFT
(Fourteen tutorials with drill on BASIC programming)

Keyboarding *(all levels)*
EDUCATIONAL ACTIVITIES
(This program is a series of twenty lessons which presents a systematic and progressive approach to learning the keyboard)

Kidstuff *(grades 1-8)*
KIDSTUFF
(Uses turtle graphics to teach programming skills)

Learn Basic *(grades 5 and above)*
COMPUTER COURSEWARE COMPANY
(A series of three programs designed to teach how to program in BASIC)

LOGO *(all grades)*
COMMODORE
Logo, includes turtle graphics, words and list, computation, sprites and music capabilities. Utility disk includes sample programs in all areas as well as instant LOGO for nonreaders. Extensive documentation is also included)

Intro to Basic/1
COMMODORE
(This program is an instructional guide that teaches the fundamentals of programming in BASIC while assuming that the user has no previous knowledge of programming)

Intro to Basic/2
COMMODORE
(The package includes a 180 page manual that contains explanations, practice drills and examples, along with a diskette with 33 programs. Learn the more advanced techniques of BASIC programming with this terrific program)

Matchmaker Series
(grade 1 and above)
AMERICAN EDUCATIONAL COMPUTER
(Authoring program for language phrases, numberals and dictionary skills)

Multiple-Choice Core
(grades 3-10)
COMPUTER COURSEWARE COMPANY
(Provides the core of a multiple-choice test program designed so the teacher can enter the questions and answers as data. Each question may have a different set of answers)

Pilot *(grades 7 and above)*
COMMODORE
(A special language that helps "nonprogrammers" design computerized quizzes and drills. For teachers, parents and students)

Simon's Basic
COMMODORE
(Expands Commodore BASIC with 114 commands such as RENUMBER and TRACE, plus graphics commands. Programmers and the novice alike love it)

SMALL *(grades 9 and above)*
MICROGRAMS
(SMALL stands for Simulated Min Assembly Level Language. Program teaches beginning concepts in assembly language programming)

Snail *(grades 3 and above)*
MICROGRAMS
(Students control a snail on the screen which teaches beginning programming concepts)

Sorting *(all grades)*
COMPUTER COURSEWARE COMPANY
(For teachers who want to write their own programs, this provides for a sort)

Spell and Define *(all grades)*
ELECTRONIC COURSEWARE SYSTEMS
(Can be used for drill and practice applications in any subject. As a

utility lesson, the teacher may enter ten terms or spelling words along with their definitions. Student record keeping included)

Step by Step *(grades 6 and above)*
PROGRAM DESIGN INC.
(An introductory course for people who wish to learn BASIC)

Super Expander 64
COMMODORE
(Easy graphics and music. Draw points, lines, arcs, circles, ellipses and polygons. Create more sprites. Easy music programming. Combine text and graphics. Adds 21 special commands to BASIC.

32 Basic Programs *(all grades)*
DILITHIUM PRESS
(Provides 32 programs and suggestions for personal modification)

Vanilla Pilot *(grades 6 and above)*
TAMARACK SOFTWARE
(Lesson design tool lets you easily create microcomputer lessons with turtle graphics and sound, using your own content/subject matter)

WATCOM Pascal *(grades 9-12)*
WATERLOO COMPUTING SYSTEMS, LTD.
(Includes sophisticated features such as text file support, pointer variables, multidimensional arrays, string functions, assembly-language interface and interactive debugging)

Pet Emulator
COMMODORE
(The ability to recapture the software written in BASIC that has been generated for the PET product)

Zortek & the Microchips
(ages 6-12)
COMMODORE
(A fun way to teach young people how to program in BASIC)

KMMM Pascal
WILSERV INDUSTRIES
(Program generates true machine language. KMMM Pascal is a sublet of Jensen and Wirth Pascal)

Logo Design Master *(all grades)*
KOALA TECHNOLOGIES CORP.
(An exciting applications program which helps children learn the popular Logo language. You can use it to create new designs, figures and displays and automatically produce the code in Logo to save your creations)

Programmer's Tool Kit
(all grades)
KOALA TECHNOLOGIES CORP.
(Provides you with an extensive collection of software tools to create new programs for the Koala Pad. The tools are programming routines in BASIC and machines language for reading Koala Pad input, creating graphics images and much more)

PowerPad Programming Kit
(all grades)
CHALK BOARD, INC.
(Once you're familiar with your computer's keyboard and you know the basics of BASIC, the PowerPad Programming Kit sets you free to develop games and programs and to bring your own creativity to the screen)

Leo's Links
CHALK BOARD, INC.
(This golf game for one or more players lets you design each hole, including fairways, roughs, traps and greens. Then using woods, irons and putters, you play the course)

Easy Lesson/Easy Quiz
COMMODORE
(The ability to easily create a lesson pool of questions from which subsequent tests or quizzes may be generated. Program has the capability of producing hard copy. The user has up to seven categories into which the questions may be classified)

ENGLISH

Adjectives *(grade 4)*
RIGHT ON PROGRAMS
(Illustrates the function and importance of adjectives)

Adjectives: Preview and Drill
(grades 5-7)
MICROGRAMS
(Student locates adjective and identifies noun it modifies)

Adjectives *(grades 4-8)*
COMM DATA COMPUTERS
(Practice in selecting adjectives from sentences)

Adverbs: Drill and Practice
(grades 5-7)
MICROGRAMS
(Locate adverb and identify the verb it modifies)

Antonyms Machine/Homonyms Machines *(grades 2-5)*
MICRO-ED
(Computer selects word, student responds with correct antonym and homonym)

Alpha-Be 4 *(grades k-1)*
COMPUTER COURSEWARE COMPANY
(Alphabet drill where student enters the the correct letter)

Alphabetical Order *(grades 2-4)*
MICROGRAMS
(Three levels with alphabetizing to the third letter)

Amazer *(grades 1-6)*
AMERICAN EDUCATIONAL SOFTWARE
(A multi-level, multi-curriculum educational game)

Academic Skill Builders in Language Arts *(grades 2-9)*
D.L.M.
(A set of six programs to provide practice in word building)

Alpha Sounds *(grades K-1)*
MICROGRAMS INC.
(Uses pictured objects and four pairs of upper and lower case letters to teach students identification of beginning sounds)

Alphabet Arcade
(grades preschool-1)
PLAYGROUND SOFTWARE
(Utilizes light pen to draw letters of the alphabet)

Alphabet Zoo
(grades preschool-grade 3)
SPINNAKER
(Teaches the relationship of letters and sounds)

Capitalization A *(grades 9-12)*
RIGHT ON PROGRAMS
(Capitalization of proper nouns and adjectives, personal titles and geographical names)

Capitalization B *(grades 9-12)*
RIGHT ON PROGRAMS
(Capitalization of day, month, holidays, historical data, names or organization, nationalities)

Capitalization C *(grades 9-12)*
RIGHT ON PROGRAMS
(Capitalization of Diety, direct quotes, poetry and titles)

Capitalization and Punctuation
(grade 3)
RIGHT ON PROGRAMS
(Teaches beginning a sentence with a capital and ending with a period)

Conjunctions *(grade 4)*
RIGHT ON PROGRAMS
(A tutorial and game to teach conjunctions)

Contractions *(grade 2)*
RIGHT ON PROGRAMS
(Teaches about contractions tests retention with game)

Coordinate *(grades 9-12)*
RIGHT ON PROGRAMS
(Practice in choppy sentences)

Commas *(grades 9-12)*
RIGHT ON PROGRAMS
(Practice in using commas)

Definder *(grades 4-8)*
COMM DATA COMPUTER
(Space game to teach about adjective)

Dictionary *(grades 7-12)*
RIGHT ON PROGRAMS
(Uses a dictionary with program to teach usage)

Endings *(grades 3-6)*
COMPUTER COURSEWARE COMPANY
(Program creates a random sentence student, picks correct ending)

End Marks *(grades 9-12)*
RIGHT ON PROGRAMS
(Correct use of period, question mark and exclamation mark)

English Invaders Games
(grades 1-8)
COMM DATA COMPUTER
(Game format teaches parts of speech)

English *(grades 3-6)*
COMM DATA COMPUTER
(Identifying parts of speech)

Funbunch *(grades 1 and above)*
UNICORN
(A three level language arts programs that includes over 2,000 words)

Game Power For Phonics, Computer *(grades k-8)*
SPIN-A-TEST PUBLISHING
(A reference of 1,687 phonics and language games giving remedial reading students intensive practice in word structure)

Grammar *(grades 1-6)*
MICRO ED
(Nouns, verb, adverb, adjective, allows individualization of study)

Homonyms I *(grade 2)*
RIGHT ON PROGRAMS
(A two-part program comprising an explanation and a game)

Homonyms II *(grade 3)*
RIGHT ON PROGRAMS
(More difficult homonyms, explains homonyms, uses game)

Homonym Match *(grades 4-6)*
COMM DATA COMPUTER
(Two player game to match homonyms)

Irregular Verbs *(grades 9-12)*
RIGHT ON PROGRAMS
(Students review and practice irregular verbs)

Mechanics *(grades 9-12)*
RIGHT ON PROGRAMS
(Mechanics of writing)

Munchword *(grades 2-6)*
COMM DATA COMPUTER
(Arcade game format uses nouns and verbs)

Nouns *(grades 4-8)*
COMM DATA COMPUTER
(Practice in selecting a noun within a sentence)

Nouns Plurals *(grades 1-6)*
COMM DATA COMPUTER
(Practice with singular and plural words)

Noticing Nouns *(grades 4-5)*
MICROGRAMS
(Lessons and test on nouns in a game format)

N-V Pattern *(grades 4-6)*
JMH
(Determining the noun and verb phrases within a given sentence)

N-V-N Pattern *(grades 4-6)*
JMH
(Determining the verb, first noun and second noun phrases within a given sentence)

N-LV-N Pattern *(grades 4-6)*
JMH
(Determining the first noun phrase, second noun phrase and linking verb phrase within a given sentence)

N-LV-Adj Pattern *(grades 4-6)*
JMH
(Determining the noun phrase, linking verb and adjective within a given sentence)

Participle *(grades 4-8)*
COMPUTER COURSEWARE COMPANY
(Student has to identify tense)

Parallel Structure *(grades 9-12)*
RIGHT ON PROGRAMS
(Illustrates errors in parallel structure in words phrases and clauses)

Quotations *(grades 9-12)*
RIGHT ON PROGRAMS
(Punctuation of direct quotes)

Recognizing Full Sentences
(grade 1)
RIGHT ON PROGRAMS
(Recognizing Nouns in a sentence)

Recognizing Nouns *(grade 1)*
RIGHT ON PROGRAMS
(Recognizing nouns in a sentence)

Recognizing Verbs *(grade 1)*
RIGHT ON PROGRAMS
(Recognizing verbs in a sentence through the use of a game)

Scrambled Sentences
(grades 2-6)
COMPUTER COURSEWARE COMPANY
(Student must unscramble words and correct punctuation)

Sentence Fragments *(grade 4)*
RIGHT ON PROGRAMS
(An introduction to sentence fragments)

Sentence Pattern *(grades 4-6)*
JMH
(Determining the correct sentence pattern used within a given sentence)

Subject-Verb Agreement
(grade 3)
RIGHT ON PROGRAMS
Teaches the principal of subject and verb agreeing)

Usage *(grades 4-12)*
COMM DATA COMPUTERS
(Student completes sentence from one of two choices)

Viewing Verbs *(grades 4-5)*
MICROGRAMS
(Locate verbs in a sentence

Who/What Etc. *(grades 3-6)*
COMPUTER COURSEWARE COMPANY
(A sentence is displayed and the student is asked for the word or phrase that is the "who" or "what" in the sentence)

Using Phonics in Context
(levels 2-4)
EDUCATIONAL ACTIVITIES
(This program enables students to master phonics by practicing phonetic skills in conjunction with semantic and syntactic information in high-interest story form. Fusing word attack skills and comprehensive skills, the learner masters phonics through a totally interactive and branching program)

Dragon Game Series for Language Arts *(grades 3-6)*
EDUCATIONAL ACTIVITIES
(This series of programs uses a game format that allows the student to review and practice parts of speech while actually having fun. Each game in the series focuses on a different part of speech)

English Basics
(grades 2 and above)
Program I—Parts of Speech
Program 2—Concepts in Language Arts
EDUCATIONAL ACTIVITIES
(The following English skills are reviewed and reinforced with student interaction: NOUNS, PRONOUNS, VERBS, ADJECTIVES, ADVERBS, HOMONYMS, SYNONYMS and ANTONYMS, CONTRACTIONS) The program first display text materials and highlight it in examples)

Punctuation *(grades 3 and above)*
Punctuation I —The Period, Question Mark and Exclamation Point
Punctuation II —The Comma
EDUCATIONAL ACTIVITIES
(An interactive-tutorial method is used to immediately involve the student with the lesson. As the punctuation introduced, the student is also given drill work consisting of inserting the correct punctuation where needed)

Capitalization
(grades 3 and above)
EDUCATIONAL ACTIVITIES
(This program covers the various uses of capital letters. Drill is used throughout the lesson to allow a continuously interactive format throughoutl both tutorial and drill sections. Several drill formats are used to maintain student interest)

Quotation Marks
(grades 3 and above)
EDUCATIONAL ACTIVITIES
(This is a series of six programs which illustrates and reviews the many uses of quotation marks and the proper punctuation of quotations. This provides an interactive tutorial presentation. Each lesson begins with a review of a particular usage followed by a drill exercise)

Grammar Word Use Skills
(grades 4-6)
AMERICAN EDUCATIONAL COMPUTER
(Sharpens skills; reinforces and expands good usage; tackles areas such as lay/lie, who/whom and many others)

Analogies
PROGRAM DESIGN, INC.
(This course defines and describes the common types of analogies. The six programs teach a method of analyzing analogies and provides practice in handling all type of analogies. Final lesson tests abilities)

The Alphabet Arcade
(ages 5 & older)
PROGRAM DESIGN, INC.
(Put letters of the alphabet in correct order. Sharpen dictionary skills by putting randomly selected words in alphabetical order. The better you get, the more difficult the word lists)

Story Builder/Word Master
(ages 9 & older)
PROGRAM DESIGN, INC.
(Story Builder: Supply the missing words to complete the computer's verses. It's a captivating way for children to learn grammar skills. Word Master: Guess the three-letter word generated by the computer. A stimulating way to learn both reasoning and vocabulary)

FOREIGN LANGUAGE

Foreign Language Series
(grades 7-12)
ISLAND SOFTWARE
(Vocabulary programs covering French, Latin, Italian and Spanish)

Camsoft *(grades 7-12)*
GESSLER EDUCATIONAL SOFTWARE
(Contains 32 interactive German programs. It reviews and drills vocabulary, grammar, verb conjugations and sentence structure. It has a text entry mode to allow you to enter your own materials)

Word Attack *(grades 7-12)*
GESSLER EDUCATIONAL SOFTWARE
(All languages—French, Spanish, German and English. Program to make learning foreign language vocabulary easy and fun)

Crossword Magic *(all levels)*
GESSLER EDUCATIONAL SOFTWARE
(This program allows you to create your own crossword puzzles. Add words from any of your language lessons)

The Linguist *(all levels)*
GESSLER EDUCATIONAL SOFTWARE
(A versatile interactive language translation program that will help students with definitions of words or phrases and pronunciation in French, Spanish, German, English, Russian, Hebrew and Japanese or any one of 13 other languages)

Spanish Vocabulary Skills
(all levels)
AMERICAN EDUCATIONAL COMPUTING
(Develops the basic Spanish vocabulary skills found in the top five Spanish I texts; strengthens Spanish-English usage and understanding)

French Vocabulary Skills
(all levels)
AMERICAN EDUCATIONAL COMPUTING
(Provides extensive vocabulary drill for use in all French I courses. It includes 98% of the standard vocabulary. There is room to add additional vocabulary to tailor the program to specific individual needs)

FRACTIONS AND DECIMALS

Adding and Subtracting Decimals *(grades 5-7)*
MICROGRAMS
(Add or subtract decimals up to the thousandth column)

Converting Decimals to Fractions *(grades 5-7)*
MICROGRAMS
(Tutorials on the process of conversion)

Converting Fractions to Decimals *(grades 5-7)*
MICROGRAMS
(Timed game format using fraction to decimal conversions)

Division With Decimals
(grades 6-8)
MICROGRAMS
(Reviews division and tutorials on decimal division)

Equal Fractions *(grades 3-6)*
COMPUTER COURSEWARE
(Shows three of the four parts of two fractions and has the student locate the missing part)

Frac Est/Soun *(grades 4-6)*
PUBLIC DOMAIN COMMODORE
(A fraction estimation game in which the student must guess the correct fractional distance to a target)

Introduction to Decimals
(grades 5-7)
MICROGRAMS
(Basic introduction with tutorial and drill)

Multiplying Decimals
(grades 5-7)
MICROGRAMS
(Game format teaching multiplication of decimals)

Percent *(grades 3-6)*
COMPUTER COURSEWARE
(Student may be drilled on eight different types of percent)

Reduce Fractions *(grades 3-6)*
COMPUTER COURSEWARE
(Student must reduce fractions)

Saucer Percent *(grades 3-12)*
COMPUTER COURSEWARE
(Two students can use the program at the same time. Game format is used)

Fractions: Addition and Subtraction *(grades 5-8)*
CBS SOFTWARE
(Program emphasizing an understanding of fractions and providing practice in solving addition and subtraction problems consisting of fractions with uncommon denominators. A special tutorial offers personal assistance in the determination of the lowest common denominator for each problem)

Fractions: Multiplications and Division *(grades 5-8)*
CBS SOFTWARE
(Provides practice in multiplying and dividing mixed fractions utilizing necessary reduction and cancellation as well as addition and subtraction)

Decimals: Addition and Subtraction *(grades 5-8)*
CBS SOFTWARE
(Emphasizing an understanding of place value as it pertains to decimals, this program gives students the opportunity to practice lining up decimals of unequal lengths in order to solve problems. The addition section offers options as to size and quantity of numbers to be added. The subtraction section allows for the selection of problems with or without borrowing)

Decimals: Multiplication and Division *(grades 5-8)*
CBS SOFTWARE
(Program furnishes practice in the multiplication and long division of 3-digit decimal numbers by 1, 2 or 3 digit decimal numbers utilizing the addition and subtraction required to arrive at a complete solution. Added emphasis is placed on an understanding of the position of the decimal point as it relates to the correct answer of each problem)

Introduction to Decimals on the Computer *(levels 2-5)*
EDUCATIONAL ACTIVITIES
(This program covers addition, subtraction, multiplication and division of decimals)

Fish-Metic *(ages 7-13)*
COMMODORE
(Review and learn the correct concepts of comparison [greater than, less than and equal to]. Then apply it to positive and negative whole numbers, fractions and decimals)

Challenge Math *(grades 2-6)*
SUNBURST
(Sound and color entice students into calculating and estimating with basic whole number and decimal operations)

Battling Bugs/Concentraction
(ages 9-12)
COMMODORE
(Battling Bugs—Positive and negative numbers. Concentraction—Equivalent fractions)

GEOMETRY

Coordinate *(grades 7 and above)*
MICROCOMPUTER WORKSHOPS CORPORATION
(Plotting points on a Cartesian coordinate system)

Geometric Shapes *(grades 3-6)*
COMPUTER COURSEWARE COMPANY
(Student identifies different geometric shapes)

Frenzy/Flip Flop *(ages 6-14)*
COMMODORE
(Frenzy—subtraction and division Flip Flop—transformational geometry)

Trap-A-Zoid *(grades 2-10)*
DESIGNWARE
(Teaches concepts as basic as square and triangle and as complex as scalene and isosceles in a game format with animation and sound affects)

Geometry Volume One
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review, and both formal and informal testing. On-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Geometry Volume Two
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review, and both formal and informal testing. On-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Frenzy/Flip Flop *(ages 6-14)*
COMMODORE
(Frenzy—subtraction and division Flip Flop—transformational geometry)

SECTION II LIBRARY SKILLS

Advanced Dewey Decimal System *(grades 3-8)*
RIGHT ON PROGRAMS
(Explains in detail how Dewey works, includes a game)

Accession Plus *(Library Management)*
RIGHT ON PROGRAMS
(List all new accessions, prepares a bibliography)

Basic Fiction Skills *(grades 3-8)*
RIGHT ON PROGRAMS
(Basic principals of shelving fiction books)

Biographies *(grades 3-8)*
RIGHT ON PROGRAMS
(Locating biographies in the library)

Catalog It *(Library Management)*
RIGHT ON PROGRAMS
(Makes card catalogs for books, computer software, records)

Learning About Catalog Cards
(grades 3-8)
RIGHT ON PROGRAMS
(Actual card catalog produced on the screen)

Learning To Use The Table of Contents *(grades 3-8)*
RIGHT ON PROGRAMS
(Table of contents used on screen)

Learning To Understand The Table of Contents Page
(grades 3-8)
RIGHT ON PROGRAMS
(Actual title page used in program)

Library Skills
(grades 2 and above)
SCHOOL AND HOME COURSEWARE
(Teaches skill to master Dewey Decimal System and to read card entries in a card catalog)

Learning To Use an Index
(grades 3-8)
RIGHT ON PROGRAMS
(A sample index is used on the screen to instruct

Learning to Locate Books On The Shelf *(grades 3-8)*
RIGHT ON PROGRAMS
(Explains the different ways books are shelved in libraries)

Learning To Understand The Card Catalog *(grades 3-8)*
RIGHT ON PROGRAMS
(The program explains the three ways to look up a book in the card catalog)

Learning to Understand The Copyright Notice *(grades 3-8)*
RIGHT ON PROGRAMS
(Teaches the meaning of copyright)

Orderit *(Library Management)*
RIGHT ON PROGRAMS
(Computer form that allows placing of orders and tracking once they have arrived)

Overdue Books *(Library Management)*
RIGHT ON PROGRAMS
(Designed as class library management program)

PRESCHOOL MATH

Counting *(grades k-1)*
COMPUTER COURSEWARE COMPANY
(Displays numbers from 1 to 10 on the screen with the speed controlled by the teacher)

Easy Match/Easy Count *(grades preschool to kindergarten)*
COMMODORE
(Eight lessons that teach shape and identification and practice in counting from one to ten objects)

Ginger the Cat Number Hunt
(preschool to kindergarten)
CARDINAL SOFTWARE
(Teaches counting and number recognition)

Learning With Leeper
(preschool)
SIERRA-ON-LINE
(Four games which focus on shape matching, counting, eye-hand coordination and creativity)

A Letter Match/More or Less
COMMODORE
(Teaches recognition and matching upper and lower case letters, matching a number of objects to a given numeral)

Number-BECI
(preschool-grading 1)
BOSTON EDUCATIONAL COMPUTING
(Learning how to count with five levels of difficulty and variable rate ability)

One,Two,Three,Fun
(preschool to kindergarten)
CARDINAL SOFTWARE
(A game to develop number recognition and counting)

Shapes and Patterns/Group It
COMMODORE
(Eight lessons teach identification of shapes and patterns that are the same and that are different; addition by grouping and subtraction by regrouping)

Ten Little Robots
(preschool-grade 2)
UNICORN SOFTWARE
(Matching and counting skills are developed)

What's Next/Letters or Numbers
(grades preschool to kindergarten)
COMMODORE
(Eight lessons teach identification of letter sequences, placement of numerals in sequential order, placing sets in sequential number order)

Astro-Grover *(preschool-grade 2)*
CBS SOFTWARE
(Offers children experience with the early math concepts of counting, addition and subtraction)

Big Bird's Funhouse
(preschool to kindergarten)
CBS SOFTWARE
(Offers children experience with important skills including auditory and visual matching and counting)

Ernie's Magic Shapes
(preschool to kindergarten)
CBS SOFTWARE
(Match shapes, identify colors, structure parts into meaningful wholes, recognize figures embedded in other figures and distinguish similarities and differences. On-screen instruction plus six skill levels)

Big Bird's Special Delivery
(preschool-grade 1)
CBS SOFTWARE
(Encourages the development of basic skills and provides a playful setting in which children can practice classifying objects. Child must consider and compare different objects according to their form, class and, on the highest level, function)

Sea Horse Hide'n Seek
(preschool-grade 1)
CBS SOFTWARE
(Emphasizes a basic understanding of color and size relationship)

A BEE C'S *(ages 3-6)*
COMMODORE
(Features the Commodore bee who guides your child in learning the alphabet and playing games that reinforce this skill. Excellent tool for young children. It talks! (with Magic Voice)

Early Childhood Learning Programs *(preschool to grade 3)*
EDUCATIONAL ACTIVITIES
(These computer activities allow young childen to acquire cognitive skills in much the same way as they acquire language. The teacher may choose from any of 20 activities to develop the use of mathematical, logical and communication skills in these curriculum areas, letter and numeral recognition, association of initial sound to a letter on the keyboard, making judgements, color recognition, directionality, following directions, decision making, classification, symmetry, shape and size, spelling and much more)

P.A.L.
Preschool Activities for Learning *(preschool to grade 1)*
EDUCATIONAL ACTIVITIES
(Simple, friendly preschool microcomputer programs that allow children to discover, experiment and learn. The programs are step-by-step reading and math readiness with appropriate graphics and rewards)

Preschool IQ Builder 1
PROGRAM DESIGN, INC.
(Challenge Part 1: Decide whether to introduce children to the computer)

PROBLEM SOLVING

Cryptogram *(grades 7-12)*
PUBLIC DOMAIN COMMODORE
(Student tries to decipher a message by solving the encoding method)

Cube *(grades 4-12)*
PUBLIC DOMAIN COMMODORE
(The computer scrambles a Rubik's Cube and the user attempts to solve it)

Flight Simul. *(grades 4-12)*
PUBLIC DOMAIN COMMODORE
(The computer simulates the flying of a small plane)

Snark *(grades 4-6)*
PUBLIC DOMAIN COMMODORE
(Player finds a "snark" on a grid by entering the center and radius of a circle in which it might be hidden)

Plato's Cave *(grades 3 and above)*
KRELL SOFTWARE CORP.
(Introduction to the relation between evidence and inference. This game offers a variety of difficulty levels and graphics options. Players are forced to operate within the confines of limited information gathering ability. It demands active probing for data and the synthesizing and resynthesizing of models of reality as play proceeds, as data is acquired, and as hypotheses are tested)

Botticelli *(grades 6 and above)*
KRELL SOFTWARE CORP.
(Players compete to teach the computer how best to interrogate their opponents in order to discover which famous people, characters in fiction, mythological beings, animals, places or things their fellow players are thinking of)

The Black Death
(grades 6 and above)
KRELL SOFTWARE CORP.
(Players fight the spread of this deadly plague by choosing strategies for inoculation. This challenging game for one or more users is designed to teach basic principles of epidemiology and public health decision making)

Galileo *(grades 7 and above)*
KRELL SOFTWARE CORP.
(Classic adventure game requiring users to search out treasures, in this case, optical components, and build a variety of scientific tools essential to their quest)

Light-Waves *(grades 6 and above)*
CBS SOFTWARE
(Allows players to control a computer environment. Through exploration and experimentation, players learn to master the Light-Waves system through logic and planning—the power of their own thinking! Light-Waves is designed to expand the horizons of thought)

Fleet Feet *(grades 6 and above)*
CBS SOFTWARE
(Students experiment; make critical choices, adapt strategies to changing conditions and learn through discovery)

The Argos Expedition
(grades 5 and above)
CBS SOFTWARE
(An adventure space game in which players must interact with each other as well as the computer, cooperate and share information)

Weather Tamers
(grades 5 and above)
CBS SOFTWARE
(Allows players to create, manipulate and control an environment within an environment—the weather system as simulated by a computer. Players each represent a region on the map and must create weather conditions to satisfy the population of that area)

Trex *(grades 4 and above)*
CBS SOFTWARE
(Users develop survival knowledge as they discover the needs of Trex under varied environmental conditions. Within four levels of activity, the user controls Trex's movements and must maintain survival levels of food, energy, water and temperature while learning which prey to pursue and which to avoid. A drastic drop in the dinosaur's health indicators can result in illness and, possibly, extinction! Scientific research has been employed in the development of the computer graphics to accurately depict prehistoric conditions. Featuring strategy-and-tactics screens and a comprehensive program guide, Trek fosters critical thinking and problem solving through role-playing in natural history)

The Honey Factory
(grades 4 and above)
CBS SOFTWARE
(Offers practice in problem solving, decision making and strategic planning while illustrating ecological principles and environmental interaction)

Comp-U-Solve *(grades 7-12)*
EDUCATIONAL ACTIVITIES
(Provides a course in logic and problem-solving and is useful to anyone in math or science courses)

LogicMaster *(all levels)*
CHALK BOARD, INC.
(With over 180,000 different game designs . . . and over 200 million secret codes . . . LogicMaster is the most fun you've ever had with your powers of reasoning. Solve the codes all by yourself or work together with family and friends)

Number Series
PROGRAM DESIGN, INC.
(1, 2, 4, 7, 11 . . . what's next? Learn how to approach number series problems and how to analyze their patterns. Then practice with increasingly difficult problems. The computer provides clues if you have trouble)

Crypto
EDUCATIONAL ACTIVITIES
(Students will have to use their skills of logic to decode CRYPTOGRAMS)

Code Breaker *(ages 10 to adult)*
PROGRAM DESIGN, INC.
(Break the computer code and figure out its messages. Start out by decoding scrambled letters; go on to tougher codes in which both letter and word order have to be unscrambled)

Memory Builder: Concentration *(ages 6 to adult)*
PROGRAM DESIGN, INC.
(Test your powers of concentration, memory and attention span by matching pairs of words hidden behind the grid of boxes on the screen)

In Search Of The Most Amazing Thing *(grades 5-12)*
SPINNAKER
(Students search for "the most amazing things" while plotting their way through alien territory)

The Factory *(grades 4 and above)*
SUNBURST
(Focuses on several problem solving strategies, including working backwards analyzing a process, determining sequence and applying creativity)

The Pond *(grades 2 and above)*
SUNBURST
(Develops the ability to form patterns)

Juggle's Rainbow
(preschool-grade 1)
SUNBURST
(Concepts such as "above-below", "left-right" and letters frequently found in reversal problems)

READING

ABC Fun *(preschool-kindergarten)*
CARDINAL SOFTWARE
(Game teaches letter recognition and sequential order)

Alphabet *(grades k-1)*
COMPUTER COURSEWARE COMPANY
(Practice with numbers and letters)

Bedtime Stories
(preschool-grade 3)
PLAYGROUND SOFTWARE
(A series of stories that utilizes a light pen to teach letter and word recognition)

Digraph *(grades 2-6)*
COMPUTER COURSEWARE COMPANY
(Computer prints a digraph and asks the student to enter a word that begins with that digraph)

Ending Sounds *(grades k-1)*
MICROGRAMS
(By pressing space bar, child picks a letter that identifies an ending sound. A summary of the child's performance is included)

Fastread *(grades 3-6)*
COMPUTER COURSEWARE COMPANY
(Flashes a word on the screen and the student types it in)

Ginger the Cat Letter Hunt
(preschool-kindergarten)
CARDINAL SOFTWARE
(Teaches letter recognition and sequence)

Introduction to Windows to Reading *(grades k-3)*
MICRO-ED
(Introduction to a group of 40 programs designed to each teach a specific instructional objective)

Kinder Koncepts *(kindergarten)*
COMMODORE
(A series of 40 programs covering reading readiness, color, pattern matching and sequence)

Learn About Sounds In Reading
(grades k-3)
AMERICAN EDUCATIONAL COMPUTERS
(Introduces phonics and presents the skills necessary, or to help reluctant readers)

Learn About Words In Reading
(grades 1-3)
AMERICAN EDUCATIONAL COMPUTERS
(Provides beginning work with word skills, contractions, compound words and more)

Learn About Words In Reading
(grades 4-6)
AMERICAN EDUCATIONAL COMPUTERS
(Offers continuing work with words covering most of the structural skills)

Learn About Words In Reading
(grades 7-8)
AMERICAN EDUCATIONAL COMPUTERS
(Advanced work in structural reading skills)

Learning With Leeper
(preschool-grade 1)
SIERRA ON LINE
(Four readiness programs in reading, math, writing and creativity)

MatchMaker *(preschool)*
COUNTERPOINT
(Reading readiness through a series of discrimination games involving colors, shapes, sizes and directions)

Professor Snead *(grades 5-9)*
MICROGRAMS
(A series of twelve programs on reading comprehension)

Reading Comprehension Skills I *(grades 1-3)*
AMERICAN EDUCATIONAL COMPUTERS
(Beginning exercises in reading with understanding concepts in cause and effect, similarities and differences, predicting outcome and main idea)

Reading Comprehension Skills II *(grades 4-6)*
AMERICAN EDUCATIONAL COMPUTERS
(Thirty-five lessons on the use of analogy, comparison and contrast, fact and opinion, sequence and judgement)

Reading Comprehension Skills III *(grades 7-8)*
AMERICAN EDUCATIONAL COMPUTERS
(Thirty-five lessons which develop advanced reading skills)

SpeedRead Plus
(grade 4 & above)
INET CORPORATION
(Teaches speed reading from 5 to 5,000 words per minute)

Vowel A *(grades 1-6)*
JMH
(Practice in recognizing the vowel sound of "A")

Vowel E *(grades 1-6)*
JMH
(Practice in recognizing and matching the vowel sound "E")

Vowel I *(grades 1-6)*
JMH
(Practice in recognizing and matching the vowel sound "I"

Vowel O *(grades 1-6)*
JMH
(Practice in recognizing and matching the vowel sound "O")

Vowel U *(grades 1-6)*
JMH
(Provides practice in recognizing and matching the vowel sound "U"

Winning With Phonics
(grades 4-8)
WISE OWL WORKSHOP
(Teaches phonics by using exercises and games)

Windows to Reading Group 1
(grades k-3)
MICRO-ED
(Selecting the matching letters using visual discrimination)

Windows to Reading Group 2
(grades k-3)
MICRO-ED
(Matching words with three letters and a short "A" vowel sound)

Windows to Reading Group 3
(grades k-3)
MICRO-ED
(Reinforces concepts from 1 & 2)

Windows to Reading Group 4
(grades k-3)
MICRO-ED
(Teaches irregular spelled words with sight recognition)

Windows to Reading Group 5
(grades k-3)
MICRO-ED
(Words that contain the short "i" sound)

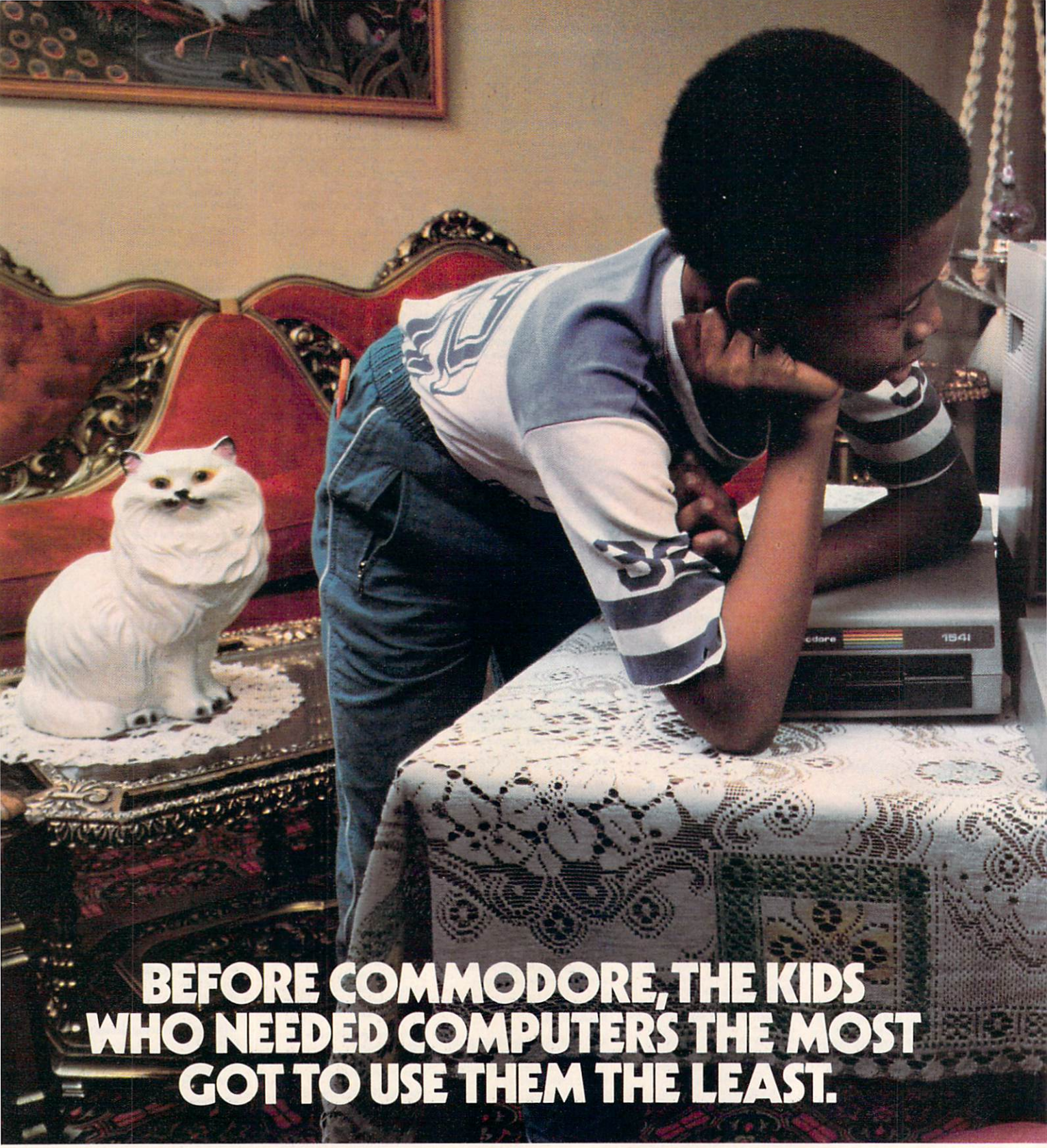
Windows to Reading Group 6
(grades k-3)
MICRO-ED
(Words with the short "u" sound)

Windows to Reading Group 9
(grades k-3)
MICRO-ED
(Uses flashing words to instill quick word cluster knowledge)

Windows to Reading Group 10
(grades k-3)
MICRO-ED
(Consonant clusters at the beginning of words)

Windows to Reading Group 11
(grades k-3)
MICRO-ED
(Drill in words that begin with br, cr, dr, tr, gr, scr & orstr)

Windows to Reading Group 12
(grades k-3)
MICRO-ED
(Words that begin with the consonant clusters bl, gl, cl, pl or tw)



BEFORE COMMODORE, THE KIDS WHO NEEDED COMPUTERS THE MOST GOT TO USE THEM THE LEAST.

It's hard to get to use a computer when you're separated from it by a store window. Or by a few hundred dollars. Or by a classroom full of kids.

But that's the way it was for a lot of kids until the Commodore 64.™

The Commodore 64 has a full 64K memory, a real typewriter-type keyboard with 66 keys, 16 color high resolution sprite graphics, high fidelity sound, and most important, a price roughly equal to that of an inexpensive color TV. And much less than a lot of comparable computers.

So households that couldn't afford a real computer with a full 64K memory can afford the Commodore 64.

And schools that couldn't afford more than one computer with 64K memory per class can now afford a lot more.

So the kid who used to sit there and gaze off into space can now explore it.

And the kids who are learning

to speak English already speak fluent BASIC.

And programming no longer means changing the channel.

And learning can be a fun experience just as fun can be a learning experience. At home or in class.

For over 25 years Commodore has been dedicated to bringing technology to the people. The Commodore PET, for example, is still the basis of computer education in many schools.

And the same commitment we make to hardware, we're making to software.

With thousands of programs that can entertain, challenge and open up a young mind to a wealth of knowledge that's no longer the special province of the wealthy.

New Educational Program Featured: Just Imagine.

COMMODORE 64

IT'S NOT HOW LITTLE IT COSTS,
IT'S HOW MUCH YOU GET.

Windows to Reading Group 13
(grades k-3)
MICRO-ED
(Words ending in nd or nt)

Windows to Reading Group 14
(grades k-3)
MICRO-ED
(Nine program package concentrates on st, sp, sk, lt, lp, lk, lm and lb)

Windows to Reading Group 15
(grades k-3)
MICRO-ED
(Word endings mp, ft, ct, pt, mpt and lts)

Windows to Reading Group 16
(grades k-3)
MICRO-ED
(A word game where the computer reveals one letter at a time)

Windows to Reading Group 17
(grades k-3)
MICRO-ED
(Using the spelling and sentence format sight words are practiced)

Windows to Reading Group 18
(grades k-3)
MICRO-ED
(Fourteen program set which emphasizes the ng and nk word endings)

Windows to Reading Group 19
(grades k-3)
MICRO-ED
(Program covers the "sh" beginning and ending words)

Windows to Reading Group 20
(grades k-3)
MICRO-ED
(Words beginning and ending with "ch")

Windows to Reading Group 21
(grades k-3)
MICRO-ED
(Six programs with words ending th, pth, gth and lfth)

Windows to Reading Group 22
(grades k-3)
MICRO-ED
(Problem endings in "ff")

Windows to Reading Group 23
(grades k-3)
MICRO-ED
(Words ending in "ss")

Windows to Reading Group 24
(grades k-3)
MICRO-ED
(Words ending with ll)

Windows to Reading Group 25
(grades k-3)
MICRO-ED
(Words ending in tt, zz, dd & gg)

Windows to Reading Group 26
(grades k-3)
MICRO-ED
(Eighteen programs dealing with words ending in "ck" and those beginning with "wh")

Windows to Reading Group 27
(grades k-3)
MICRO-ED
(Fourteen programs dealing with "qu" or "squ")

Windows to Reading Group 28
(grades k-3)
MICRO-ED
(Six programs deal with comprehension of words ending in "x", "xt" and "xth")

Windows to Reading Group 29
(grades k-3)
MICRO-ED
(Eighteen programs instruct the differences between digraphs, dipthongs and simple vowels concentrating on the "ee")

Windows to Reading Group 30
(grades k-3)
MICRO-ED
(Set of six programs distinguishes between the sounds "eer" and "ear")

Windows to Reading Group 31
(grades k-3)
MICRO-ED
(Fourteen programs dealing with the sound of "ea")

Windows to Reading Group 32
(grades k-3)
MICRO-ED
(Ten program lessons dealing with "oo" sound)

Windows to Reading Group 33
(grades k-3)
MICRO-ED
(Ten programs that deal with the "oo" or "ai" sounds)

Windows to Reading Group 34
(grades k-3)
MICRO-ED
(Ten programs dealing with the "air" and "ay" sounds)

Windows to Reading Group 35
(grades k-3)
MICRO-ED
(Ten programs of different formats dealing with the "oa" sound)

Windows to Reading Group 36
(grades k-3)
MICRO-ED
(Ten programs teaching the "ou" and "oar" sound)

Windows to Reading Group 37
(grades k-3)
MICRO-ED
(Ten programs teach how to discriminate between the "our" and "ow" sounds)

Windows to Reading Group 38
(grades k-3)
MICRO-ED
(Six programs dealing with the "aw" sound)

Windows to Reading Group 39
(grades k-3)
MICRO-ED
(Six programs dealing with the "au", "oy" and "oi" sounds)

Windows to Reading Group 40
(grades k-3)
MICRO-ED
(Ten programs dealing with the silent "e")

Word Flyer *(grades k-3)*
ELECTRONIC ARTS
(Teaches pattern recognition with two, three and four letter words in an arcade style format)

Word Fun I *(grades k-2)*
COMM DATA COMPUTER
(Student fills in blank using one of three words)

Word Spinner *(grades 1-4)*
THE LEARNING COMPANY
(Vocabulary building game)

Reading Comprehension: What's Different
(ages 8 and older)
PROGRAM DESIGN, INC.
(Select the word that doesn't belong in the series. Analytical skill and reading comprehension are the keys to mastering the challenge)

Memory Builder: Concentration *(ages 6 to adult)*
PROGRAM DESIGN, INC.
(Test your power of concentration, memory and attention span by matching pairs of words hidden behind the grid of boxes on the screen)

KinderComp *(grades k-3)*
SPINNAKER
(Six reading and computer literacy lessons)

Facemaker *(grades k-3)*
SPINNAKER
(Create funny faces on screen while improving concentration and memory skills)

Hey Diddle Diddle *(grades 1-4)*
SPINNAKER
(Popular three-part program for nonreaders to beginning readers)

Big Bird's Funhouse
(preschool to kindergarten)
CBS SOFTWARE
(Offers children experience with important skills including auditory and visual matching and counting)

Sesame Street Letter-Go-Round
(preschool-grade 2)
CBS SOFTWARE
(Provides practice in recognizing and matching letters and words, simple spelling and word formation. At the touch of a key on the EasyKey, one of three Muppet pals brings out a letter to match or a word to spell and drops it on the seesaw. A letter appears on each Letter-Go-Round basket and as it spins, children must find the right letter to match or complete a word. When the match is made or a word is completed, BIG BIRD, BERT and COOKIE MONSTER will dance and cheer children on to the next round of play)

Big Bird's Special Delivery
(preschool-grade 1)
CBS SOFTWARE
(Encourages the development of basic skills and provides a playful setting in which children can practice classifying objects. Child must consider and compare different objects according to their form, class and, on the highest level, function)

Webster: The Word Game
(grade 2 and above)
CBS SOFTWARE
(A game that teaches recognition of word patterns and practicing letter sequencing skills)

Pathwords *(grade 4 and above)*
CBS SOFTWARE
(A unique letter-connection challenge that makes you pick up where you left off! Up to four players race against the clock to link together adjacent letters and create words)

Diascriptive Reading I
(levels 1-5)
Diascriptive Reading II
(levels 3-8)
EDUCATIONAL ACTIVITIES
(The programs diagnose the reading skills of each student, prescribe what is needed for improvement, and evaluate performance at each level before directing student to the next program)

Our Weird and Wacky World
(grades 2-4)
EDUCATIONAL ACTIVITIES
(Story based activities include fill-ins, look-alikes, cloze practice, ordering, etc.)

Readability Index
EDUCATIONAL ACTIVITIES
(Using the Bormuth Formula, which has proved to be one of the most accurate readability equations, this program enables the user to determine the readability of any text by approximate grade level)

Our Wild and Crazy World
(grades 4-9)
EDUCATIONAL ACTIVITIES
(Short humorous stories taken from the pages of newspapers and magazines make this computer-assisted reading program interesting to secondary and adult reading students)

The O'Brien Vocabulary Placement Test
EDUCATIONAL ACTIVITIES
(A graduated vocabulary test that will find a student's independent reading level quickly)

How to Read in the Content Areas *(grades 5-8)*
EDUCATIONAL ACTIVITIES
(A skills development program that utilizes the unique capabilities of the computer to personalize, individualize and interact with the student to help him/her learn content area reading)

Science Content Area Reading
(grades 6-9)
EDUCATIONAL ACTIVITIES
(These high interest cloze lessons guide students to mastery in reading science materials)

Crypto
EDUCATIONAL ACTIVITIES
(Students will have to use their skills of logic to decode CRYPTOGRAMS)

Micro-Read *(grades 1-8)*
AMERICAN EDUCATIONAL COMPUTER
(Provides developmental practice on word analysis, comprehension, and study skills, in addition to vocabulary development. Includes vowel sounds, consonant blends, prefixes, suffixes and more. Micro-Read is packaged by grade level)

SCIENCE SOFTWARE

Blackbox *(grades 7-12)*
MICROGRAMS
(Based on how rays fired into a box deflect, absorb, or reflect, the student attempts to locate a known number of objects)

Chemistry Crossword
(grades 9-above)
MICROGRAMS
(Fifty words and definitions from basic Chemistry in a crossword puzzle format)

Atomic structure *(grades 10-12)*
PROGRAMS FOR LEARNING
(Practice and drill and simulation in a nine lesson format)

Chemical Equilibrium
(grades 10-12)
PROGRAMS FOR LEARNING
(Ten programs dealing with various aspects of chemical equilibrium)

Chemistry With a Concept
(grades 10-12)
PROGRAMS FOR LEARNING
(Eleven programs including a copy of CHEMISTRY WITH A COMPUTER)

D-RT *(grades 6 and above)*
SCHOOL AND HOME COURSEWARE
(A simulation to study the concept of relative motion)

Good Health Habits *(grade 1)*
RIGHT ON PROGRAMS
(Covers tooth care, eye care, good eating and sleeping habits)

Home Automatic Weather Station *(grades 5 and above)*
VAISALA, Inc.
(Program includes hardware which measures barometric pressure, relative humidity and dew point and software which forecasts and teaches about the weather.

Heart Lab *(grades 9-12)*
EDUCATIONAL ACTIVITIES
(Animated graphics provide a simulation for learning how the heart works. Tutorials and drill identify specific parts of the heart and how they work. Students can enter their own pulse rate and the animated display of the heart will show how their hearts will function.

Light *(grade 6)*
RIGHT ON PROGRAMS
(Comparison of light and sound also covers lasers)

Linear Kinematics/Projectile Motion *(grades 11 and above)*
MICROPHYS PROGRAMS
(Programs covering linear motion and the analysis of a graph of instantaneous speed versus time. Analysis of a projectile in flight)

Mammals *(grades 8-12)*
RIGHT ON PROGRAMS
(Teaches about the basic characteristics of mammals)

Matter and Energy *(grade 6)*
RIGHT ON PROGRAMS
(Covers the concepts of matter and energy, a game is included)

Micrometer *(grades 5 and above)*
SCHOOL AND HOME COURSEWARE, Inc.
(Program teaches how to use a micrometer)

The Mole Concept/The Molarity Concept *(grades 10-12)*
MICROPHYS PROGRAMS
(Generates questions dealing with the mole concept and the writing of chemical formulas)

Momentum and Energy Energy and the Inclined Plane
(grades 11-12)
MICROPHYS PROGRAMS
(Program covers linear motion, impulse kinetic energy, motion of a particle on an inclined plane, work and potential energies)

Motion Problems I *(grades 8-11)*
MICROCOMPUTER WORKSHOPS
(This program teaches uniform motion problems for vehicles going in the opposite direction)

Naming Compounds Drill Formulas of Compounds Drill
(grades 10-12)
MICROPHYS PROGRAMS
(The program generates questions dealing with the mole concept, morality and the writing of chemical formulas)

Parts of the Microscope
(grades 9-12)
EDUCATIONAL ACTIVITIES
(Tutorial with drill to teach parts and function of the microscope)

Percent Concentration/ph Concept *(grades 10-12)*
MICROPHYS PROGRAMS
(Computer generates questions on concentration and ph concept)

Periodic Quiz, Chemical Formulas, Chemical Nomenclature and Titration
(grades 9-12)
MICROGRAMS
(Four programs cover a periodic quiz, chemical formulas, chemical nomenclature with questions and titration simulates a lab experiment

Plants and How They Grow
(grades 5-9)
RIGHT ON PROGRAMS
(Describes trees and plants, tells function of each part)

Physics Crossword
(grades 9 and above)
MICROGRAMS
(A test on terms used in beginning physics)

Series Circuit Analysis
Parallel Circuit Analysis
(grades 11-12)
MICROPHYS PROGRAMS
(Questions on a circuit consisting of 3 resistors and battery and analysis of a parallel circuit with 3 resistors and a battery)

Space Mission Problem Solving
ORANGE CHERRY MEDIA
(Simulation where students must understand distance, time, volume, rate as they deal with dust storms, alien spaceships and supply problems on their outerspace exploration)

Titration *(grade 9)*
MICROGRAMS
(A simulation providing training in titration experiments)

Thermometer *(grades 6-9)*
COMPUTER COURSEWARE COMPANY
(Students must enter readings from a thermometer display)

Think or Swim *(grades 3-8)*
MICROGRAMS
(Students answer general science questions to play a game)

Biology Volume One
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing. On-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Biology Volume Two
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing. On-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Biology Volume Three
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing. On-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Biology Volume Four
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing. On-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Chemistry Volume One
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing. On-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Chemistry Volume Two
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing. On-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Physics Volume One
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing. On-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Physics Volume Two
(grades 7-12)
PRENTICE HALL
(Offers 3 different teaching modes—progressive tutorial, full review and both formal and informal testing. On-going testing tracks the student's progress. Student can interrupt the program to ask questions, ask for help and test progress at any time)

Dinosaur Dig *(grades 3-9)*
CBS SOFTWARE
(Dinosaur Dig begins with an electronic journey back into geologic time during which kids explore and learn all about dinosaurs, from where they lived to why they died. Dino Discovery lets kids select specific dinosaurs to learn about. Dino Flash is an illustrated game of prehistoric flash cards, while Dino Dig asks kids to identify dinosaurs from partial clues)

Forecast! *(grades 4 and above)*
CBS SOFTWARE
(Provides scientific explanations for weather conditions in addition to forecasting the weather itself. The comprehensive program guide explains the language of forecasting and provides extensive resource materials for further study)

T. rex *(grades 4 and above)*
CBS SOFTWARE
(Computer simulation where users develop survival knowledge as they discover the needs of Trex under varied environmental conditions. Within four levels of activity, the user controls Trex's movements and must maintain survival levels of food, energy, water and temperature while learning which prey to pursue and which to avoid. A drastic drop in the dinosaur's health indicators can result in illness and, possibly extinction! Scientific research has been employed in the development of the computer graphics to accurately depict prehistoric conditions. Featuring strategy-and-tactics screens and a comprehensive program guide, Trex fosters critical thinking and problem solving through role-playing in natural history)

The Honey Factory
(grades 4 and above)
CSB SOFTWARE
(Offers practice in problem solving, decision making and strategic planning while illustrating ecological principles and environmental interaction)

The Black Death
(grades 6 and above)
KRELL SOFTWARE CORP.
(Players fight the spread of this deadly plague by choosing strategies for inoculation. This challenging game for one or more users is designed to teach basic principles of epidemiology and public health decision making)

Galileo *(grades 7 and above)*
KRELL SOFTWARE CORP.
(Classic adventure game requiring users to search out treasures, in this case, optical components, and build a variety of scientific tools essential to their quest)

Cells *(grades 3-9)*
EDUCATIONAL ACTIVITIES
(Illustrates and explains the fundamental parts and functions of cells. Animated graphics are used in both programs to aid in teaching about the cell. The programs contain both tutorial and drill formats)

Parts of the Microscope
(grades 7-9)
EDUCATIONAL ACTIVITIES
(Program teaches the student to identify the various parts by location and function)

MatchMaker Biology
(grades 9 and above)
AMERICAN EDUCATIONAL COMPUTER
(This program is designed to supplement any introductory course in biology. This program helps the learner master the biology vocabulary more readily)

Elementary Science Facts
AMERICAN EDUCATIONAL COMPUTER
(Three programs for grades 3-4, 5-6 and 7-8. Topics included are categorized into the broad branches of science education: life science, earth/space science and physical science)

SOCIAL STUDIES

Ancient Civilizations *(grade 6)*
RIGHT ON PROGRAMS
(Users are introduced to early Greek and Roman civilizations. Famous names and places are given with information about each)

Beginning Geography *(grade 1)*
RIGHT ON PROGRAMS
(Students are introduced to the basic directions as well as map symbols)

Canada *(grades 4 and above)*
MICROGRAMS
(A test on facts about Canada)

Challenge It *(grade 5)*
RIGHT ON PROGRAMS
(Tutorial, questions, games and activities on Indian life, American patriotic songs and American inventions)

Challenge It *(grade 6)*
RIGHT ON PROGRAMS
(Programs on the ancient world, the middle ages and the renaissance. The programs include tutorials, questions, games and a crossword puzzle)

Communications *(grade 6)*
RIGHT ON PROGRAMS
(A history of communications)

Community Helpers *(grade 2)*
RIGHT ON PROGRAMS
(Explains the services that communities provide. A game is included)

Early Humans *(grade 6)*
RIGHT ON PROGRAMS
(Explains how prehistoric people lived, a game is included)

Growth of the United States
(grade 4)
RIGHT ON PROGRAMS
(Discussion of United States growth as an industrial nation, a game is included)

The Great Maine to California Race *(grades 5 and above)*
HAYDEN SOFTWARE COMPANY
(Car race with progress determined by ability to answer questions about states)

Hammurabi *(grades 4-6)*
PUBLIC DOMAIN COMMODORE
(Player "rules" a country making economic decisions concerning land management, distribution of food and other criteria)

Holidays and Festivals *(grade 1)*
RIGHT ON PROGRAMS
(Explains national holidays in the United States and tests student learning with a matching game)

The I Love America Series
(grades 4-7)
RIGHT ON PROGRAMS
(Students work with maps of the United States to learn about historical facts)

The Middle Ages *(grade 6)*
RIGHT ON PROGRAMS
(An introduction to basic historical information about the Middle Ages)

Our 50 States
(grades 4 and above)
MICROGRAMS
(Quiz game where two students answer questions about the states)

Presidential Fever
(grades 7 and up)
DATA-WIN
(A game for one or two players where the object is to win the presidential election. Five levels of difficulty are selectable)

Society *(grades 5-12)*
COMPUTER COURSEWARE COMPANY
(Simulation allowing the student to control a society)

States of The United States
(grade 5)
RIGHT ON PROGRAMS
(Presents basic information on the states)

Transportation *(grade 2)*
RIGHT ON PROGRAMS
(A history of transportation)

Tug of War *(grades 5-7)*
MICROGRAMS
(Two player game with options of The Revolutionary War, The Civil War, The Spanish American War, World War I and World War II)

U.S. Constitution
(grades 7 & above)
MICRO LAB
(Tutorials and tests on the United States Constitution)

Who Built America *(grade 4)*
RIGHT ON PROGRAMS
(Outlines lives of men and women who came to America to start a new life)

World Polar Regions
World Desert Regions
World Mountain Regions
(grade 3)
RIGHT ON PROGRAMS
(Separate programs on climate, animals, birds, trees and flowers of each region)

Your Community *(grade 1)*
RIGHT ON PROGRAMS
(Compares small towns and large cities, includes a game)

America Coast-To-Coast
(grades 5-9)
CBS SOFTWARE
(Five geography games in one: State Facts provides a quick review of the names, capitals, years of statehood, shapes, mottos and selected industries of each of the 50 states. State Quiz is a computer-generated Q & A based on material presented in State Facts. Mystery State asks kids to identify a state from the facts presented and scores them on how many guesses they make. Across the USA is a multiple skill level travel game in which kids' knowledge of state boundaries helps them trek from one state to another. State-Shoot combines dexterity with learning as kids try to bull's-eye a given state and then identify it)

Simulation Annam: The Study of a Developing Country
(grades 7 and above)
EDUCATIONAL ACTIVITIES
(Students use the game to discover the consequences of various decisions and find the most appropriate responses to given situations)

Regions of the United States
(grades 5-12)
EDUCATIONAL ACTIVITIES
(This game teaches the major cities, landforms, products and climates of the different regions of the U. S.)

U. S. Geography Facts
(grades 4-6)
AMERICAN EDUCATIONAL COMPUTER
(Provides facts and information about our states, cities, landmarks, lands, waterways and climates. Lessons are broken into geography areas such as Midwest, Pacific, Great Lakes, etc.)

World Geography Facts
(grades 4-6)
AMERICAN EDUCATIONAL COMPUTER
(Sharpens geography skills and knowledge; helps identify and locate continents, countries, cities and oceans)

World History Facts
(grades 8 and above)
AMERICAN EDUCATIONAL COMPUTER
(This program can be used in any introductory world history course. Important dates, facts and events are covered in a format that encourages easy recall)

U. S. History Facts
(grades 8 and above)
AMERICAN EDUCATIONAL COMPUTER
(Designed to supplement any introductory course. It covers important dates, facts and events in a format that encourages easy recall)

U. S. Government Facts
AMERICAN EDUCATIONAL COMPUTER
(This program is designed to be used for the following applications: Grade 8—American History, Grade 9—Civics, High School electives in government and College refresher courses in government and American History)

SECTION VI SPELLING AND VOCABULARY

Antonyms *(grades 4-6)*

JMH
(Version of the game "Concentration" matching antonyms)

The Complete Spelling Program *(grades 4 and above)*
SLED SOFTWARE
(Programs for students with special needs in spelling, it covers five basic spelling rules necessary for encoding words)

End-it *(grades 1-6)*
JMH
(Practice in adding endings to root words)

Etymology *(grades 9-12)*
RIGHT ON PROGRAMS
(Explains how to derive word meanings)

Homophones *(grades 4-6)*
JMH
(Practice in using words that sound the same but are spelled differently)

Like Word *(grades 2-6)*
COMPUTER COURSEWARE COMPANY
(A program to pick words of similar spelling or definition)

Missing Letter *(grades 1-6)*
COMPUTER COURSEWARE COMPANY
(A word is flashed on the screen then put back with a letter missing and the student must spell it correctly)

Missing Sentence *(grades 2-6)*
COMPUTER COURSEWARE COMPANY
(Program prints a sentence with a word missing, student enters the correct word)

Phonograms *(grades 1-8)*
JMH
(Complete a list of words ending in the same letters by adding one or two letters. Can be used with or without sound)

Puzzle It *(grades 2 and above)*
RIGHT ON PROGRAMS
(Designed to foster vocabulary development and an understanding of nuance and pronunciation)

Rocket Spell *(grades 1-8)*
JMH
(Ten groups of commonly misspelled words are used in a game where the student uncovers letters to guess the word)

Rocket Spell C *(grades-all)*
JMH
(Same as Rocket Spell except your own words may be added. You can enter up to ten lists with up to twenty words in each list)

Scramble Letters *(grades 1-8)*
JMH
(Letters must be unscrambled to spell a word correctly)

Scramble Letters C *(grades 1-12)*
JMH
(Same format as Scramble Letters but with the ability to add your own words)

Scramble Spell *(grades 1-8)*
JMH
(Student must unscramble commonly misspelled words)

Scramble Spell C *(grades-all)*
JMH
(Same as Scramble Spell; however, you can add your own words)

Spell
(grades 1-8)
JMH
(The 100 most commonly misspelled words at the elementary level are grouped into 10 groups)

Spelling *(grades 9-12)*
RIGHT ON PROGRAMS
(A five part series that reviews specific spelling rules with their most common exceptions)

Spelling II *(grades 10-12)*
RIGHT ON PROGRAMS
(A five lesson program that reviews plurals, possessives, suffixes and prefixes, also provides spelling practice)

Steps to Spelling Breakthrough I *(grades 2-4)*
EMC PUBLISHING
(Focuses on the words that are commonly misspelled by over half of the students who take New Iowa Spelling Scales and Arthur Gates Spelling Difficulties tests.)

Steps to Spelling Breakthrough II *(grades 5-6)*
EMC PUBLISHING
(Focuses on the words that are commonly misspelled by over half of the students who take the New Iowa Spelling Scales and Arthur Gates Spelling Difficulties tests)

Steps to Spelling Breakthrough III *(grades 7-8)*
EMC PUBLISHING
(Focuses on the words that are commonly misspelled by over half of the students who take the New Iowa Spelling Scales and Arthur Gates Spelling Difficulties tests)

Stuntman *(grades 9-12)*
SYNCHRONIZING EDUCATION AND GAMES
(Correct spelling of a word allows for game mode)

Synonyms *(grades 4-6)*
JMH
(Version of the game "Concentration" matching synonyms)

Tictactoe Spell *(grades 1-8)*
JMH
(The most commonly misspelled words at the elementary level are used in a tic-tac-toe game format)

Tictactoe Spell *(grades 1-12)*
JMH
(Same format as Tictactoe Spell with the ability to choose your own word list)

Vocabulary Builder *(grades 2-3)*
MICROGRAMS
(A word puzzle helps students match words with definitions)

Vocabulary Expander
(grades 9 and above)
MICROGRAMS
(Six programs with over 450 words have students race against the clock)

Warrior Word
(grades 4 and above)
MICROGRAMS
(Spelling game where user can set level and speed)

Word/Phrase Practice
(grades 1-6)
MICROGRAMS
(Words or phrases of instructors choice are entered and then presented with a letter missing and required to fill in the blank)

Word Quest *(grades 2-10)*
COMPUTER COURSEWARE COMPANY
(Students must answer questions from a word list)

Word Searches *(grades 3-12)*
COMPUTER COURSEWARE COMPANY
(User makes a pattern using words on a grid)

Word Zapper
(grades 2 and above)
MICROGRAMS
(Six programs with over 200 words in each, student tries to zap misspelled words as they go across the screen)

Spellakazam *(grades 2-6)*
DESIGNWARE
(Comes with 400 words from the Silver Burdett Spelling program. Provides for own word lists and sentences to be entered. Presented in a game format as a race against a magician to release hidden animals)

Spellagraph *(grades 2-8)*
DESIGNWARE
(Decoding secret messages while practicing spelling from 400 words from the Silver Burdett Spelling program. User may also input own words and lists)

Spellicopter *(grades 1-5)*
DESIGNWARE
(Action spelling game with 400 words in 40 lists)

Alexander The Great
(grades 4 and above)
KRELL SOFTWARE CORP.
(Game for developing word and arithmetic skills)

Shakespeare And The Dragon
(grades 3 and above)
KRELL SOFTWARE CORP.
(This spelling game introduces Shakespeare as a mentor to the player in the Sword of Zedek program. When help is requested, Shakespeare poses spelling questions. Depending on speed and accuracy of responses, he confers secret information useful to overthrow Ra, Master of Evil. Levels available range from elementary through college)

Sesame Street Letter-Go-Round
(preschool-grade 2)
CBS SOFTWARE
(Provides practice in recognizing and matching letters and words, simple spelling and word formation. At the touch of a key on the Easy Key, one of three Muppet pals brings out a letter to match or a word to spell and drops it on the seesaw. A letter appears on each Letter-Go-Round basket and as it spins, children must find the right letter to match or complete a word. When a match is made or a word is completed, BIG BIRD, BERT and COOKIE MONSTER will dance and cheer children on to the next round of play)

Spelltronics *(grades 4 and above)*
EDUCATIONAL ACTIVITIES
(A systematic approach to spelling that utilizes the letter cloze technique to reinforce correct spelling and build visual memory. SPELLTRONICS is useful for all students who have trouble spelling)

Scrambled Letters
(grades 4 and above)
EDUCATIONAL ACTIVITIES
(The computer presents spelling words with the letters scrambled. Two students compete to unscramble the letters keying in the correctly spelled word)

Rhymes and Riddles
(grades k-5)
SPINNAKER
(Letter guessing game improving spelling and vocabulary skills. Reviews keyboarding skills. Excellent graphics and music used throughout)

KoalaGrams
KOALA TECHNOLOGIES CORP.
(Makes spelling and word recognition challenging as well as fun. The bear cursor moves around the screen to pick up letter and unscramble words. There are many categories of words to choose from and clues are given for each word. You can even enter your own word lists to help you with homework or special problem words)

MICRO-Spell *(grades 2-8)*
AMERICAN EDUCATIONAL COMPUTER
(This program teaches the 4,233 most commonly written words in the English language)

Vocabulary Word Builder
(grades 4-6)
AMERICAN EDUCATIONAL COMPUTER
(Works on the principle of matching words and phrases)

Vocabulary Builder 1: Beginning
PROGRAM DESIGN, INC.
(Eleven programs include a set of graded vocabulary questions on synonyms and antonyms)

Vocabulary Builder 2: Advanced
PROGRAM DESIGN, INC.
(Eleven programs include a set of graded vocabulary questions on synonyms and antonyms like those in Vocabulary 1, but using a more advanced word list)

Code Breaker *(ages 10 to adult)*
PROGRAM DESIGN, INC.
(Break the computer code and figure out its messages. Start out by decoding scrambled letters; go on to tougher codes in which both letter and word order have to be unscrambled)

TESTING AND GUIDANCE

English SAT 1
(grades 9 and above)
MICRO LAB
(A study aid for the verbal portion of the SAT test, containing sections of antonyms, analogies, sentence completions, reading comprehension and grammar. Questions in tutorial mode give explanations for every answer choice, correct and incorrect. Questions in test mode are given as in the SAT test, with scoring; then missed questions are regiven in the tutorial mode)

English SAT 2
(grades 9 and above)
MICRO LAB
(Study aid for the verbal portion of the SAT test, concentrating on root words as a basis for all skills necessary to do well on the SAT. Questions in tutorial mode give explanations for every answer choice, correct and incorrect. Extra help screens and practice are given for important concepts. Contains different materials than English SAT 1)

English SAT 3
(grades 9 and above)
MICRO LAB
(Study aid for the verbal portion of the SAT test. Same format as SAT 1 and SAT 2 but with different materials)

Foto-Flash *(grades 1 and above)*
SCHOOL & HOME COURSEWARE, INC.
(This game-format package is designed to enable students to improve short-term memory and recall, and visualization skills. From a displayed list of letters, numbers or words, students type in the characters from memory, in forward and reverse sequence)

Krell College Board SAT* Exam Preparation Series
(college)
KRELL SOFTWARE CORP.
(Complete coverage of all math and verbal areas. Diagnostic analysis of skills. Ability to develop individual study plans. Unlimited drill and practice. Simulated SAT* exam questions. Questions in SAT* format and difficulty level. Instantaneous answers and scoring. Solutions and detailed explanations. Complete classroom record management system including performance monitoring and analysis [optional at additional cost]. Comprehensive vocabulary building package [optional at additional cost]. Complete and systematic instruction in mathematics and verbal skills [optional at additional cost])

Mastering The SAT *(college)*
CBS SOFTWARE
(A full-length SAT pre-test gauges initial performance levels and pinpoints areas needing improvement.)

Preparing For The SAT
PROGRAM DESIGN, INC.
(Teaches more than subject matter; teaches how to take the SAT and other aptitude tests)

Quantitative Comparisons
PROGRAM DESIGN, INC.
(Eight programs that prepare students for SAT-type math problems. Problems start with elementary concept and cover most material that would appear in the test)

WORD PROCESSING

Bank Street Writer *(all grades)*
SCHOLASTIC, INC.
(A simple-to-use word processor for the beginning writer. Clear directions are in front of the student at all times. User can correct, revise, recognize and manipulate sentences and paragraphs while retaining the original work for comparison)

Cut and Paste
(grades 3 and above)
ELECTRONIC ARTS
(A simple word processor designed for the home or school user. Easy to learn on-screen information makes memorizing key stroke commands unnecessary)

Word Worker *(grades 7-12)*
DESIGN ENTERPRISES OF SAN FRANCISCO
(A word processing system written in BASIC. Features include word wrapping, semiautomatic hyphenation, footnote insertion, automatic paging and chapter-head formatting)

Paper Clip *(adult)*
BATTERIES INCLUDED
(Powerful word processor that is versatile and full featured.

Advanced features include horizontal scrolling, column manipulation and alphabetic sorting. Adapts to most printers)

Wordpro 3 Plus 64
PROFESSIONAL SOFTWARE INC.
(A popular full featured word processor)

Wordpro 64
PROFESSIONAL SOFTWARE INC.
(A popular full featured word processor with extra features: horizontal scrolling, additional text areas and choice of background color and more)

Rapidwriter
H. D. MANUFACTURING
(A flexible word processor that lets you write, save, recall, edit, format and print any kind of text. There are no limits to document length or the variety of ways that texts may be mixed and recombined to produce labels, letters, reports, newsletters, scripts and books)

TOTL.TEXT
TOTL. SOFTWARE
(A complete word processing program which allows you to create and format professional looking documents, including research papers with footnotes, form letters with keyboard input and columnar reports. There is no limit to length of document since it may be created in sections, saved, then printed in sequence)

Easy Script 64
(grades 9 and above)
COMMODORE
(Word processor providing many features of large business machines: Displays 764 lines by 40 characters. Prints more than 130 columns. Global/local search/replace/hunt/-find, super/subscripts, insert/delete characters, lines, sentences, paragraphs and much more)

Word/Name Machine
(grades 9 and above)
COMMODORE
(Easy to learn, easy to use word processing program designed as an entry level program for list-making files. Capable of generating personalized form letters)

Magic Desk *(grades 6 to adult)*
COMMODORE
(Word processing and information filing program. All Magic Desk commands are pictures directed by joystick control. Sound effects and screen animation make typing and filing fun)

Easy Mail
COMMODORE
(A full featured name and address program for the serious user that requires a complete name and address system for small businesses, clubs or organizations)

WRITING

Coordination *(grades 8-12)*
RIGHT ON PROGRAMS
(Gives practice in combining short, choppy sentences)

Commas *(grades 8-12)*
RIGHT ON PROGRAMS
(Practice in inserting commas in separating word series, introductory phrases, nonrestrictive clauses, parenthetical expressions and appositives)

Excess Words *(grades 8-12)*
RIGHT ON PROGRAMS
(This program illustrates how to cut back in the number of words used)

Faulty Coordination
(grades 8-12)
RIGHT ON PROGRAMS
(Explanation of errors given and student uses exercises provided to recognize and correct faulty coordination)

Fragments *(grades 8-12)*
RIGHT ON PROGRAMS
(Practice in recognizing and correcting sentence fragments in both sentences and paragraphs)

Improved Writing Style Advanced *(grades 8-12)*
RIGHT ON PROGRAMS
(Set of five programs to improve writing style)

Improved Writing Style Basic
(grades 8-12)
RIGHT ON PROGRAMS
(Aimed at the student who wants to write more effectively)

Misplaced Modifiers
(grades 8-12)
RIGHT ON PROGRAMS
(Provides practice in identifying dangling modifiers and correcting phrase and clause modifiers to improve clarity of sentences)

Parallel Structure *(grades 8-12)*
RIGHT ON PROGRAMS
(Programs illustrate errors in parallel structure in words, phrases and clauses)

Run-on-Sentences A
(grades 8-12)
RIGHT ON PROGRAMS
(Reviews basics of use of commas and end marks to avoid run-on sentences and comma errors)

Run-on-Sentences B
(grades 8-12)
RIGHT ON PROGRAMS
(Additional practice in basics with coordinating conjunctions and conjunctive adverbs added)

Sentence Beginnings
(grades 8-12)
RIGHT ON PROGRAMS
(Improving style through varying sentence beginnings)

Sentence Structure Errors
(grades 8-12)
RIGHT ON PROGRAMS
(Set of five programs dealing with the most common errors)

Just Imagine
(preschool and above)
COMMODORE
(Teaches writing skills and allows children to write their own stories)

Story Writer *(grades 1-3)*
PUBLIC DOMAIN COMMODORE
(A simple word processor designed for primary students. Prints out in enhanced print if desired)

Subordination *(grades 8-12)*
RIGHT ON PROGRAMS
(Combining sentences through use of subordination)

Writing Competency Program
(grades 7-12)
EDUCATIONAL ACTIVITIES
(This highly motivating writing competency program is designed to instruct the student in three basic and essential areas of writing skills: Letter Writing, Report Organization and Persuasion)

Just Imagine
(preschool and above)
COMMODORE
(Teaches writing skills and allows children to write their own stories)

WATCOM

Products for the Commodore 64

Waterloo Structured BASIC

Already widely used on the Commodore PET, the package augments the standard BASIC with:

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- comprehensive textbook containing both a primer and a reference manual

Price: $99.00; $79.00 for additional packages in same order

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- comprehensive textbook containing both a primer and a reference manual

Price: $149.00; $99.00 for additional packages in same order

Ordering Information

Order forms and/or additional information may be obtained from:

WATCOM Products,
415 Phillip Street,
Waterloo, Ontario
Canada, N2L 3X2

(519) 886-3700
Telex: 06-955458

Additional textbooks are also available. Seminars on Pascal and BASIC are offered regularly.

Circle Reader Service No. 15

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Public Domain Software

What follows is a list of Public Domain software which is available through Commodore Educational dealers. These programs are the results of the efforts of hundreds of Canadian educators, numerous school boards in Ontario and a large number of programmers. Since these programs are in the public domain, they are available through education dealers at a nominal copying charge and can be copied and modified by the user. While everyone of the public domain programs has been checked at least five times, there is always the possibility that an error may appear. Since these programs are in the public domain and are distributed solely as a service to educators, no support or warranty by Commodore is either expressed or implied.

ALGEBRA, TRIGONOMETRY AND CALCULUS

Algebra Drill *(grades 7-8)*
Algebra Vectors *(grades 9-12)*
Binomial Expander40 *(grades 9-12)*
Binomial Drill *(grades 8-12)*
Calculus *(grades 9-12)*
Co-Ordinates *(grades 4-8)*
Collect Terms *(grades 7-8)*
Collecterm *(grades 7-8)*
Collecterms *(grades 7-8)*
Curve Fit *(grades 9 and above)*
Deriv of Poly *(grades 9 and above)*
Equation x-y *(grades 7-8)*
Equation *(grades 7-8)*
Equation *(grades 7-8)*
Exponent Multiplication *(grades 7-8)*
Exponents *(grades 7-8)*
Factor Drill *(grades 7-12)*
Factor Tri *(grades 7-8)*
Factor Trinomials *(grades 7-12)*
Factor Whole *(grades 4-8)*
Factorial *(grades 7-12)*
Factors *(grades 4-12)*
Function Plot *(grades 9 and above)*
Gauss Reduct *(grades 8-12)*
Graph Plot *(grades 7-8)*
Hi Calculus *(grades 7-12)*

ARITHMETIC

Add Drill *(grades 4-6)*
Adding Drill *(grades 1-3)*
Additions and Subtractions *(grades 1-6)*
Adding Quiz *(grades 1-3)*
Addition *(grades 7-12)*
Addition Game *(grades 1-3)*
Addition Race *(grades 4-6)*
Add Teacher *(grades 1-3)*
Arithmetic Drill *(grades 4-6)*
Arithmetic *(grades 4-6)*
Arithmetic *(grades 4-6)*
Basic Math *(grades 1-6)*
Between *(grades 1-3)*
Big Divide *(grades 4-6)*
Big Math *(grades 1-3)*
Big Subtract *(grades 7-8)*
Bomb Addition *(grades 4-6)*
Brain Crane + *(grades 4-6)*
Brain Crane Division *(grades 1-6)*
Brain Crane Multiplication *(grades 1-6)*
B.T.C.Add *(grades 4-6)*
B.T.C.Divide *(grades 1-3)*
B.T.C.Multiplication *(grades 1-6)*
B.T.C.Subtract *(grades 1-3)*

BUSINESS EDUCATION

Accounting *(grades 9-12)*
Amortization Table *(grades 9-12)*
Amortization *(grades 7-12)*
Bonds *(grades 4 and above)*
Calendar *(all grade levels)*
Commodity *(grades 7-8)*
Comp Typing *(grades 7-9)*
Cost Good Sold *(grades 7 and above)*
Date *(all grades)*
Debit and Credit *(grades 9-12)*
Debit Credit *(grades 9-12)*
Depreciation and Payment *(grades 9-12)*
Depreciation *(grades 9-12)*
F.I.F.O. *(grades 7-12)*
Gross Pay *(grades 6-8)*
Ice Cream *(grades 4 and above)*
Investments *(grades 9-12)*
Letter Man *(grades 2 and above)*
Life Tables *(grades 7-12)*
Market Crash *(grades 7-12)*
Market *(grades 7-12)*
Money Flow *(grades 4-8)*
Mortgage *(grades 9-12)*
Objective *(grades 7-12)*
Portfolio *(grades 7-12)*
Simple Interest *(grades 7-8)*
Stock Market *(grades 7-12)*
Stock *(grades 4-6)*
Typing Drill *(grades 4-8)*
Typing *(grades 4 and above)*

ENGLISH

A Journey *(grades 4-8)*
A or An *(grades 1-3)*
A Story *(grades 1-6)*
Alpha'zation *(grades 1-6)*
Alpha *(grades 4-6)*
Alphabet Quiz *(grades 1-3)*
Alphabet Worm *(grades 1-3)*
Alphabet *(grades 1-3)*
Alphabetizing *(grades 1-6)*
Alphabetter *(grades 1-6)*
Alphashift *(grades 1-8)*
Antonym *(grades 1-8)*
Contractions *(grades 6-8)*
English *(grades 4-8)*
Grammar *(grades 4-8)*
Grammar 4 *(grades 7-8)*
MM Homonyms *(grades 1-6)*
MM Lad *(grades 1-3)*
MM Sad Story *(grades 1-3)*
MM VB Forms 1.4 *(grades 1-3)*
MM VB Forms 3.4 *(grades 1-3)*
MM VB Forms 4.4-9.4 *(grades 1-3)*
MM word *(grades 1-3)*
Nouns *(grades 4-8)*
Paws *(grades 1-6)*
Plurals *(grades 1-3)*
Swap Old Rom *(grades 4-6)*
Two To Too *(grades 4-8)*
Verb Choice *(grades 1-3)*

FOREIGN LANGUAGE

French Drill *(grades 4-8)*
French Numbers *(grades 1-3)*
Le Pendu *(grades 4-8)*
Revue Passe *(grades 4-8)*
Verbes *(grades 7-8)*

FRACTIONS AND DECIMALS

Big Binary *(grades 7-12)*
B.T.C. Fractions *(grades 6-8)*
Decimal Arithmetic *(grades 4-8)*
Decimal Size *(grades 4-6)*
Fraction Game *(grades 4-6)*
Fraction Practice *(grades 4-6)*

GEOMETRY

Geometry *(grades 4-8)*
Geometry Terms *(grades 4-8)*
Int/Ex Angles *(grades 4-8)*
Intersection *(grades 7-8)*

PROBLEM SOLVING

A V or M *(grades 1-6)*
Android NIM *(grades 4-8)*
Bottlecaps *(grades 4-8)*
Butch & Slim *(grades 4-8)*
Chess Board *(grades 4 and above)*
Concentration *(grades 1-8)*
Craps *(grades 4-12)*
Draw Cave *(grades 4-8)*
Energy *(grades 4-8)*
Fur Trade *(grades 4-12)*
Gunner *(grades 4-12)*
HI-Q *(grades 4-12)*
In-Order *(grades 4-8)*
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(grades 4-6)
Geog. Test
(grades 4-6)
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(grades 4-6)
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(grades 9-12)
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(grades 7-8)
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(grades 4-12)
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(grades 4-12)
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(grades 4-6)
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(grades 4 and above)
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(grade 6)
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(grade 7)
Scramble 8
(grade 8)
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(grades 4-6)
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(grades 4-6)
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(grades 1-8)
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(grade 3)
Speed Spell 4
(grade 4)
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(grade 5)
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(grade 6)
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(grade 7)
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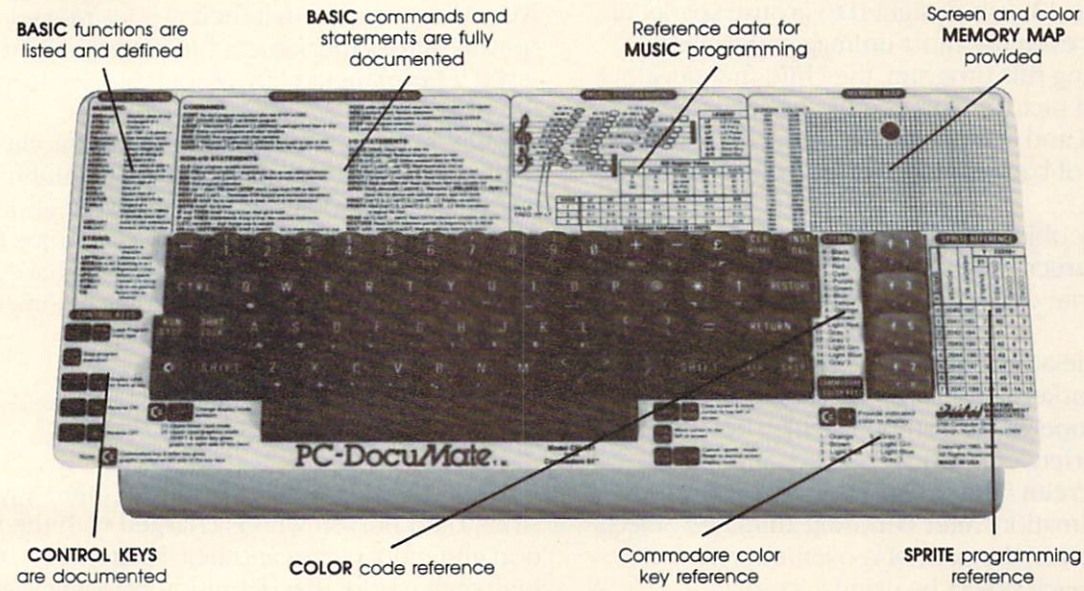

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Exciting New Educational Software from Commodore

Seven new educational packages being marketed by Commodore for the Commodore 64 challenge and delight school-age youngsters—and maybe even their parents.

Just Imagine . . . A Teacher's Viewpoint

By Vernettia A. Foster

Peirce Middle School
West Chester, Pennsylvania

Just Imagine for the Commodore 64 is a unique educational computer program aimed at children ages three to 13. It is designed to arouse sparks of creativity in even the most unimaginative child.

When using this program, the child first develops an animated picture. This is done by selecting a background and stationary and animated objects. The choice of backgrounds varies from a circus to outer space.

Stationary objects include, among other things, a rocket, a scarecrow, a swing set, a knight, an Indian and (a favorite of the children) a huge green dragon.

Among the animated objects are a jogger, a construction worker, an underwater diver, a monkey and a tightrope walker. Students enjoy being able to choose a variety of stationary objects and often cover the screen with them. They especially appreciate the animation. After choosing animated objects for their stories, the path of movement may be plotted for each object by using a joystick.

Once a story has been created pictorially, the child may begin to use *Just Imagine's* word processing function. The animated picture comes to life when a related word story is typed into the computer. This introduction to the word processor allows the child to develop typing skills, to improve spelling and reading skills and, most important, to increase creative writing ability. In addition, the child learns editing skills as well.

Seeing one's own picture and story on the screen is exciting to a child of any age. And after using the word processor, the child's story may be printed on paper for future enjoyment.

Just Imagine possesses several unique attributes. For example, while loading different segments of the program, instead of the traditional "One Moment Please," the program displays over 300 facts of interest randomly on the screen. Outstanding graphics, music and special sound effects add the finishing touches to this excellent program.

Just Imagine has been tested by sixth-grade students at Peirce Middle School in West Chester, Pennsylvania. These students were fascinated by the program. Especially interesting to them was the animation. Most of these students were being introduced to the word processor for the first time. They were disappointed that their stories moved so quickly across the screen, but were pacified when given a permanent copy of their stories from the printer.

I highly recommend *Just Imagine* for classroom and personal use. Students become uninhibited when writing and are more concerned about perfecting their writing. *Just Imagine* is unique because it provides students the opportunity to have fun creating a story and then to enjoy the excitement of seeing it come to life.

Learning Tutor Math Series

By Gail Austin

The word tutor always brings to mind a rather strict, rigid person who is charged with the instruction and guidance of another. Fortunately, in this high-tech world, that definition no longer applies. Thanks to Commodore's new EduKat *Learning Tutor Math Series*, the image of a tutor will be one that children from the ages of ten to 15 will equate with fun and learning. This complete software series consists of four packages containing a total of 26 programs that cover addition and subtraction (6 programs), multiplication and division (6 programs), graphing and geometry (7 programs) and decimals (7 programs).

Most educational programs tend to be either drill-and-practice or tutorial. The *Learning Tutor Math Series* is both—depending on the needs of the child. Unlike most tutorials, which make the students go through every step this series allows the

opportunity to decide whether or not they need to see each step in solving the problem.

Another unusual but highly effective part of these programs is the use of randomly generated problems in the tutorial sections. Often tutorials show only one or two problems in the explanation and once they are shown, the tutorial is of relatively little use. That is not the case in this series. Each lesson seen by the students is unique and therefore valuable. Plus there is always an option to exit the lesson at any time the student feels comfortable with the topic as it is explained.

Each program in the series includes an introduction, instructions, lesson, questions and a report card. The introduction contains the specific objective for each program. The instructions outline the different features which are built into the software and tell how to operate the software for optimum learning. The lessons are specific and show very graphically how the problems are solved in a step-by-step manner.

The question section provides from five to 20 problems. Again, these are randomly generated so that children can use the program over and over until they understand the concept being taught. If the children answer a problem incorrectly, they are given another chance. If they are unable to answer correctly the second time, they are given the opportunity to see this problem answered in a lesson format. In this way, the *Learning Tutor Math Series* actually teaches the children where the error was made.

In addition, the question section provides options for the children to review the instructions, lessons and directions as well as to obtain hints. The hints can be given whenever needed, thus ensuring that the children will attain success. This option along with the opportunity to graphically see how to do the problems correctly makes the program worth its rather low price tag. Where else can your children get individual help as soon as needed? Unfortunately, that kind of help is not always possible.

Finally, the program provides a detailed report card which can be displayed on the screen or printed out on paper. The report card comes in two stages. The first gives a detailed explanation of how well the student did on each question. The second part gives a summary of the child's overall performance.

This series was written for children who should be able to read the explanations given. However, as with any program, if a child has a reading problem, an adult can help the child read any written explanations as the computer shows the actual steps.

Sky Travel—A Window on Our Galaxy

Sky Travel is truly a window on our galaxy from any place on Earth. The magic of microelectronics has made it possible to have an accurate model of our galaxy in your own home. All you have to do is select your commands and *Sky Travel* returns the information in pictorial form on your screen.

Special function keys were created to make it easy to find your way around our galaxy. With these keys, *Sky Travel* allows you to locate and identify any object you see in the sky, view the sky from anywhere on Earth and make sky and planetary sky charts. The program also has an accelerated time clock so you can observe events as they are happening. You can also view the sky 10,000 years into the past or future.

Sky Travel allows you to locate and identify any object you see in the sky, view the sky from anywhere on Earth and make sky and planetary charts.

Sky Travel shows the location of more than 1200 stars, the 88 constellations (major ones with optional line drawings), the sun, the moon (with phases), the eight planets (besides the Earth), a large number of deep-sky objects and Halley's comet during its appearance in 1985/86. Using the functions available, you can get an overview (appropriate for a novice) or a detailed look that will excite any astronomer, to further pursue the splendor of our galaxy. If you have a printer, you may even make a permanent record of any screen display you create. You can even create, view and print your own star and planetary charts!

For those who are real astronomy buffs, *Sky Travel* includes sophisticated information such as the calculations for precession and the shifting (wobbling) of the Earth's axis as it rotates. This shifting, approximately 50.27 seconds of arc per year, accounts for the fact that the North Star we see today is not the same star used in 2600 B.C.

The manual that accompanies *Sky Travel* makes the program appropriate for the inexperienced user as well as the seasoned astronomer. The program and accompanying manual serve a dual purpose. They foster a beginning interest in astronomy and extend prior learning by encouraging research and further study into astronomy.

Sky Travel—A Window on Our Galaxy is actually designed for anyone from an expert to someone

who occasionally looks at the sky and wonders what a particular object may be.

Meeting the Challenge of the 80's: *The Reading Professor*

By Emily Watts
Commodore Educational Software

Many people have found it difficult to meet the increased reading demands of a fast-paced technological age. More and more students are graduating from high schools lacking the necessary comprehension skills to cope with the demands of higher education or business careers. If you fit into either of these two categories, Commodore's latest software program, *The Reading Professor*, can help you increase your reading speed while improving comprehension at the same time.

This educational reading package is targeted for three audiences—high school, college or adult and professional—each with its own library of reading passages. The program consists of three major components: lessons, exercises and profile reports. By working through the lessons and exercises, the user learns specific techniques for eliminating unproductive reading habits and developing new skills which improve speed and comprehension.

The Reading Professor is structured in such a way as to accommodate a user at home as well as in a classroom setting. There are ten lessons focusing on eliminating faulty habits, vision expansion, avoiding regression, establishing a rhythm pattern, phrase recognition, comprehension skills, study skills, advanced visual expansion and skimming versus speed reading.

Each lesson begins and ends with a timed reading passage and comprehension check. In the lesson which follows, the objective is identified, the speed reading technique is explained and instructions for the exercise in that lesson are given. The user then has an opportunity to practice the technique in the exercise and in the concluding timed reading and comprehension check. Immediate feedback is given and the user generally has the option of repeating the lesson and/or doing additional exercises.

The exercise component in *The Reading Professor* is designed to give extra practice to increase reading speed. There are seven types of exercises: timed readings, tachistoscope, ladders, stretching, scales, phrases and depths. The exercises are included in the lessons, but they can also be used independently at the user's discretion. This added flexibility increases the options for use of *The Reading Professor*. Users can select particular exercises and review lessons they have already worked as fits their needs. For example, a user experiencing particular difficulty with establishing a rhythm pattern could do extra exercises with the tachistoscope, ladders and scales to develop this skill.

An advantage of using the exercises independently is that the user is given the option of selecting the material from a library of reading selections representing different areas of interest and types of literature. The user also has the option of controlling other dimensions of the exercises as well, such as speed of words presented, page width and height, spacing and top/bottom curtain.

The final component, the profile reports, provides positive feedback on the user's performance. Results of comprehension checks and timed reading passages, which are displayed immediately upon completion of activities, are also recorded on individual profiles. Results can be displayed in both chart and graph form on the screen or on paper to enable the user to identify personal strengths and weaknesses as well as give positive reinforcement.

***The Reading Professor* can help you increase your reading speed while improving comprehension at the same time.**

Visual representations of improved reading times and comprehension scores can increase confidence and provide motivation for further improvement.

The builtin flexibility of *The Reading Professor* expands its value beyond one-time use. Periodic use can maintain overall skills, improve specific areas of weakness or apply speed-reading techniques to a particular type of literature.

Included with *The Reading Professor* is a detailed user's manual which explains everything from general load instructions to descriptions and explanations of lesson formats, and the philosophy behind speed reading.

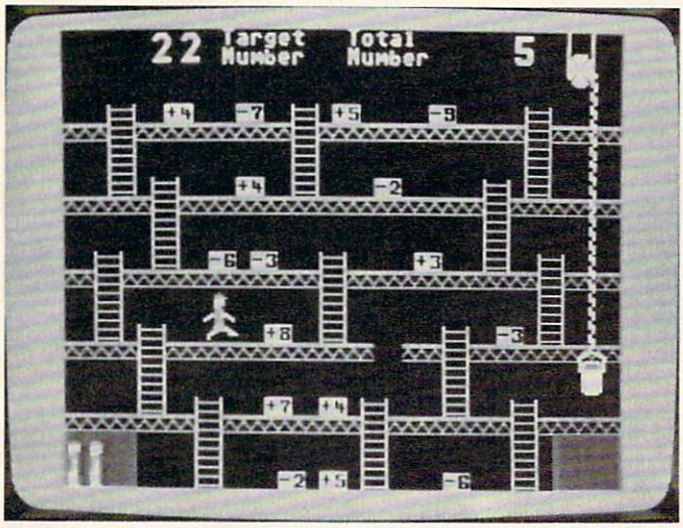
Number Builder

By Gail Austin

There was once a time when parents could complain about the educational value of video games for the home. With new products like the *Number Builder* for the Commodore 64, that is no longer possible. It is often easier for true learning to take place when it does not seem like work, and that is what makes *Number Builder* so valuable.

This educational program really lets children

have fun practicing their math skills in addition, subtraction, multiplication and division because there are twelve different levels of play, four different speeds, options to use either a joystick or the keyboard for control, screen formats similar to those of the most highly rated and popular video games, sound and graphics to give plenty of feedback as to how well the player is doing and opportunities to develop logical thinking skills to solve the math problems.



Number Builder

Upon reading the manual, which is complete and also helpful in choosing the proper levels, parents might be somewhat skeptical in believing that their children can really develop those logical thinking skills by using this game. However, the program was designed with this in mind. The children have time to study the screens before beginning the actual play. Therefore, a mathematical strategy for solving the problems can be planned.

Now that most of the educational reasons for buying *Number Builder* have been listed, it is time to give the other reason—how much fun the game is to play. *Number Builder* was designed around the things kids love to do. Things like building, climbing ladders, having targets to reach, solving problems before the time is up, earning money for a job well done and avoiding the traps.

As a result, the screen consists of a construction site with lots of ladders to climb, holes to avoid, a target number to reach and number/operation blocks, which need to be picked up. The worker's job is to reach that target number by picking up the right blocks which are calculated to a work number. When the work number and the target number are the same, the workmen shout and then wait in the office until all three workmen on each level are finished. The fun part is trying to get the right blocks before a bucket of paint on a pulley reaches the top of the screen. If that happens, the paint spills and what a mess it makes! The real payoff comes when the three workmen go and collect their money from the cashier. With success comes the chance to try a higher level.

One of the cutest parts of the game is that the speed of the game is determined by the choice of the workmen. The workmen feature Mr. Plot walking slowly, Mr. Walker walking at a normal pace, Mr. Swift walking quickly and Mr. Speedy running.

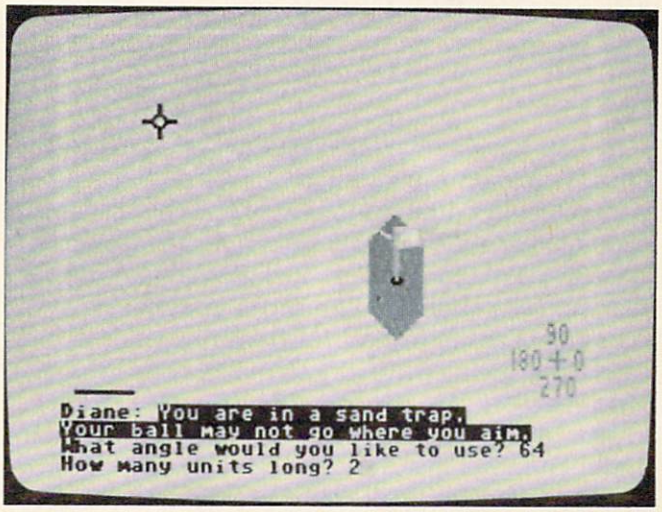
Even if parents were totally against video game formats, *Number Builder* will most likely change their minds. Those of you who say you can't learn while having fun have obviously not seen this Commodore product.

Go ahead and paint the town—OOPS!—paint a level in *Number Builder*.

Golf Classic/Compubar

By Doreen Carson
Commodore Educational Software

If you are handicapped by your understanding of angles, then the latest Milliken program from Commodore, *Golf Classic/Compubar,* will be sure to put you on the green. No caddie necessary here as all you'll need to bring along is a keen eye for angle and distance.



Golf Classic

Determine your aim by entering the angle and number of units the ball will travel. You can use positive or negative angles, and an onscreen grid is a ready reference as you attempt to bring your math skills up to par. Distance units vary for each hole. You can advance a unit smaller than the one given for the hole by using decimals (4.7, 2.1).

You have the chance to play all 18 holes or only as

many as you choose. Your goal is to choose the correct driving angle and the appropriate distance units to reach the hole in the least number of shots. The course is different and challenging at every tee. You can play through the course solo or enjoy the competition as part of a group as large as a foursome. Whether driving to the green, chipping out of the rough or putting into the hole your math and map reading skills are sure to improve after a round or two of *Golf Classic*.

Computation with concrete objects is the topic of *Compubar*. Using the operations of addition and subtraction, you aim to create a red bar the same length as the green target bar that the program provides. Your bar may not be shorter than zero or longer than 15 units. A scale is displayed to give you a point of reference from which to begin your calculations. Careful addition and subtraction of the blue work bars will let you hit the mark as you aim for the green target. Reading bar graphs and calculating with graphic representations of numbers won't be a problem when using *Compubar*.

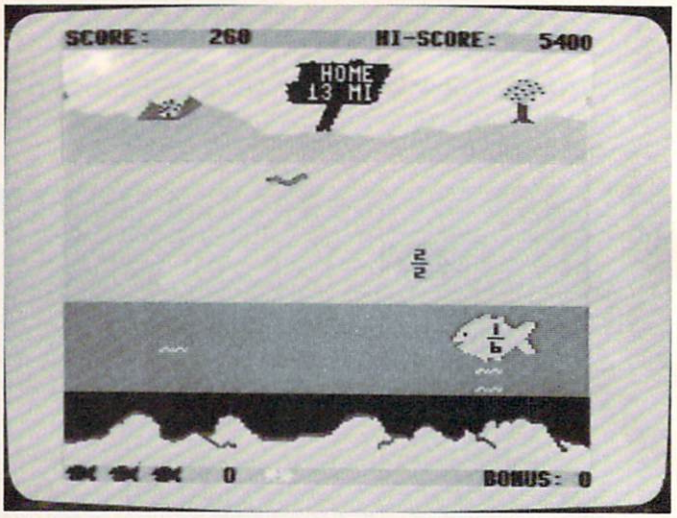
This new addition to the Commodore Milliken line comes with a manual, complete with suggestions to extend the learning of the concepts reviewed in the programs. Included also is a wipe-off activity card for keeping score while playing *Golf* and designing your own version of *Compubar*. These programs will provide interesting practice in problem solving for users ages nine through 14.

Fish-Metic

By Gail Austin

You've heard of wives' tales, fairy tales and folktales. Now even fish tales have invaded the world of computers in Commodore's new *Fish-Metic*. This arcade-quality educational program for the Commodore 64 uses a joystick and includes all the features that motivate children to improve in their understanding of mathematical relationships while at the same time giving the children the fun of playing a video game.

How many times have you purchased a program and then found that the older family members do not like having to do the baby problems before getting to problems on their level? *Fish-Metic* solves that problem. It allows from one to four players to choose their own level of difficulty from the 15 that are offered. The sixteenth level can only be entered after successfully completing the fifteenth. These levels help to improve an understanding of greater than, less than, and equal to, while providing practice in comparing both positive and negative whole numbers, fractions and decimals and give practice in comparing decimals to fractions and vice versa. With such a large number of levels, *Fish-Metic* can be used by children of many ages. This can be a great benefit to parents who want to get their money's worth.



Fish-Metic

But what else makes this program worth it? The graphics are great and you have a good time. You move your goldfish, which has a number on its side on every level but the first. Swimming a total of 15 miles, the goldfish encounters other fish swimming in the same direction who need to be avoided and passed. You gain points for passing the small fish. There is also a large numbered fish which swims toward the goldfish. The relationship of the numbers on the two large fish are periodically changing. These numbers determine whether or not you move the goldfish over, under or on top of the other large fish. Correct movement of the goldfish results in points as explained in the manual.

Having a total of three fish lives, the ability to earn bonus points by eating worms and using the undertow to its best advantage makes *Fish-Metic* even more challenging. You even can try to top the high score which is displayed at the top of the screen. However, the most fun comes when you succeed in completing the 15-mile swim. Then you can compete in the Speed Run, a special faster, 15-mile version which earns even more points when completed successfully. This part of the program really makes you want to win!

The manual is clear and well-written which makes it easy to decide what level you should choose. In the manual you will also find a complete description of what is found on each level.

You may never become a great fisherman with this game, but you may have a great fisherman's tale to tell about *Fish-Metic*. If not at least you will enjoy practicing mathematical relationships! **C**

Educational Software:

Products That May Change Our World

By Betsy Byrne

A new approach to educational software makes learning come alive.

Nineteen eighty-four was the year in which educational software came into its own. Nowhere was this more apparent than at the Consumer Electronics Show in Chicago's McCormick Place convention center. Almost every exhibit showed evidence of a quiet revolution; a revolution that is sure to radically change the way our children will be educated from now on. If the designers and manufacturers of these new products are successful, and I have every reason to think they will be, our children will no longer have to be mass produced by our educational system according to some imagined average-student template, in which the children who cannot or will not conform to this standard fall by the wayside. With microcomputers in homes and schools and brave new educational software allowing individualized instruction (that, until now, has been beyond the capabilities of any but the most expensive private schools), many educators believe that we are in the process of making the first significant changes in our educational structure since the inception of the American public school system.

Who are the designers and manufacturers of these products who, by changing the lives of our children, may change the very world we live in? Why do I (and many education professionals) feel that the software they are creating is any different from the educational products of the past?

Because, at long last, the majority of designers are professional educators themselves, working in conjunction with many of the best programmers in the business. The companies that are offering new educational wares for both home and school markets run the gamut from small unknowns to well known giants. Programmers who have spent their time devising fast-action games or bigger and better databases, are turning their talents to creating programs for the education marketplace that are just as slick and exciting as their previous efforts.

Educational software is no longer taking a back seat to game or productivity products—either in quality or in the dollars spent on advertising and marketing. Gone are the days when educational software was no more than text transferred to a high-tech medium. Gone too, at least in most products, are the grammatical errors, misspellings and instructions far beyond the target age group's ability to understand.

Many children get turned off to school because they don't see how the things they are learning apply to what they are interested in or because they feel they are being denied the freedom to express personal creativity in classrooms that are geared to a common denominator. Microcomputers and a new creative curriculum could go a long way toward making learning come alive. Kids from all walks of life will be able to discover learning as it has always been meant to be: a fascinating, exciting journey that ends only with the end of life itself.

Many children get turned off to school because they don't see how the things they are learning apply to their lives.

The report that follows, covering individual companies and their products, is by no means complete. It represents the Commodore-compatible educational software that I was able to look at in three days of concentrated study, or products (and information about products) that were later provided to me by manufacturers. There were so many new offerings in this category that no one individual could possibly become familiar with them all. Some items are merely mentioned, some are described in much detail. This in no way reflects on the quality, worth or virtue of the product (other than as mentioned)—only on my own tastes and interests and the amount of time I was able to spend evaluating the item. Some products touched only briefly will be reviewed in greater detail in future issues.

Hayden Software, 600 Suffolk Street, Lowell, MA 01853 800-343-1218

Hayden recently introduced new SAT preparation software, joining several other major education publishers in competing for the dollars spent by parents of college-bound students. Determined to give their offspring an edge in the fierce competition for scholarships and a better chance at entering the school of their choice, parents and grandparents spend (what I consider) big money (up to $300 for the products of some companies) on computer software to help increase their child's SAT scores.

I had a chance to try out the Hayden software, with my 15 year-old serving as a guinea pig, and I was very pleased with it. It comes as three separate modules: math ($39.95) which has three disks covering algebra, geometry, quantitative comparisons and word problems; verbal ($39.95), which has two disks covering vocabulary and reading comprehension; and sample SAT tests ($19.95) which has two disks containing a pretest to give some idea of a student's strengths and weak areas and sample SAT tests to gauge the user's improvement.

Softsync Inc., 14 East 34th Street, New York, NY 10016 212-685-2080

Softsync announced *Sensei* (pronounced Sen-say, the Japanese word for professor), a series of instructional programs ranging from how to use and maintain your computer to lessons on writing BASIC programs. Softsync manufactures one of my favorite programs, *The Computer Mechanic*, as well as many other home-oriented programs and games.

Infocom, 555 Wheeler Street, Cambridge, MA 02138

From Infocom comes (not surprisingly), an adventure game for beginning adventurers. *Seastalker*, according to the company, is an adventure in the tradition of Jules Verne's *20,000 Leagues Under the Sea*. Written by Jim Lawrence, author of some 60 (!) fiction novels for juveniles, this should be a real winner if it is up to Infocom's usual standards.

Yes, I think adventure games can be educational! They help develop reading skills and give the user experience in logical reasoning and problem solving, among other attributes. Learning should be fun.

Adventure games like Seastalker *help develop reading skills.*

Creative Software, 230 East Caribbean Drive, Sunnyvale, CA 04089

Bumblebee is a program for kids that, like LOGO and other fun computer languages, teaches skills needed for computer programming. Using short, easy-to-remember commands (mostly directional), children teach a honey bee to navigate around the screen, collecting pollen from flowers. The bee then returns to his hive with his spoils—if the young programmers have no bugs in their program and have avoided dangers such as spiders and frogs by inserting IF-THEN statements in the proper place!

Krell Software Corporation, 1320 Stony Brook Road, Stony Brook, NY 11790 516-751-5139

Krell is producing some impressive-sounding programs for home users. I have not yet tried these programs, but the descriptions sounded so intriguing that I wanted to pass them along.

Alexander the Great develops word and arithmetic skills and permits equal competition between players at different skill levels. *Plato's Cave* is billed as an introduction to the relation between evidence and inference. This was designed for users aged eight to adult and sounds neat. *Shakespeare and the Dragon* sharpens spelling skills in adventure-game format. In *The Black Death*, players fight the spread of a deadly plague. Designed to teach the principles of epidemiology and public health decision-making.

Connections sounds like a mega-game and it has a mega-price compared to most software for the Commodore—$99.95. Krell says it was designed to demand as well as teach the arts of scientific reasoning, mental agility and intellectual acuity. Topics on the database include geography, chemistry, mammals, mathematics, tools and everyday objects. It allows users to create their own databases and has a Connection User Group, whose members exchange databases for the game.

SAT Preparation Series is marketed in three versions: the $299.95 Gold Label (expanded series), the $299.95 Blue Label (complete series) and the $139.95 Red Label (condensed series). The Gold Label carries a guarantee of an 80-point increase on SAT scores or your money back. Krell's SAT's won *Creative Computing*'s Outstanding Software Award

for 1984 and was chosen for CES's Software Showcase, a special exhibition of exceptional software chosen by a team of well-known reviewers from the computer publishing industry.

The Learning Company, 545 Middlefield Road, Suite 170, Menlo Park, CA 94025 415-328-5410

This company's products have received a lot of press lately and for good reason. They incorporate some of the most innovative concepts seen in educational software to date and have received numerous awards and mentions. I won't try to describe them all here, but I will list the ones that now run on the 64 and mention one that I hope we can look for soon on our machine, *Robot Odyssey I*.

Robot Odyssey I is billed as a robot construction kit within an exciting adventure game. Designed for teenagers and young adults, *Robot Odyssey I* is the next step beyond Learning Company's *Rocky's Boots*, which has been called an electronic erector set and won several awards. *Rocky's Boots* is available on the 64, as well as *Moptown Parade* and *Moptown Hotel* in the company's Logic series; *Juggle's Rainbow*, *Reader Rabbit, Word Spinner* and *Magic Spells* are available for reading; and *Bumble Games, Bumble Plot* and *Addition Magician* in math.

Entech, 10733 Chiquita, Studio City, CA 91604 818-768-6646

Entech showed a talking version (no accessories needed) of *Space Math 64*, as well as an updated, high-resolution version of *Studio 64*, their music program that topped the charts for several months. *Studio 64* and its companion program *Add Mus'In*, are the programs that our family uses at home to make music. We like them because *Add Mus'In* allows us to take the tunes we compose or copy from sheet music and add them to our own programs and animations simply and easily. There are a lot of music programs on the market lately, but just as with any other software category, the best program for you is the one that fits your needs. Although not specifically designed as an educational or teaching program, my own children and kids in two nearby schools have begun learning to read and create music with *Studio 64*.

Prentice-Hall, P.O. Box 819, Englewood Cliffs, NJ 07632 201-592-2611

Prentice-Hall recently announced *Arrakis Advantage*, from Arrakis Systems written in a new graphic language called Soc Rates. Named after the founder of interactive dialogue in education, *Advantage* allows students to maintain a dialogue with the computer. Students are able to ask the computer to explain mathematical principles, give examples, draw diagrams and answer questions pertaining to the lessons—in effect, talk to Socrates. The student's level can be tested from within the courseware and the presentation adapted accordingly.

According to Prentice-Hall the 18 modules for grades seven through 12 were designed based on exhaustive research and analysis of current curricula across the United States. Subjects covered are algebra, biology, chemistry, geometry, physics and statistics, with each module (priced at $39.95) targeting a particular grade level. I have to agree with the publishers when they say that good useful educational software for children in this age group has been sparse. The Socrates system allows students to explore interrelated ideas and branch out in directions based on his or her interests.

Sunburst Communications, 39 Washington Avenue, Pleasantville, NY 10570 914-769-5030

Sunburst is a name well known and long respected in microcomputer educational circles, along with that of Marge Kosel, Sunburst Microcomputer Division Vice President and Educational Director and designer of many of Sunburst's award-winning titles. Sunburst titles that run on the Commodore 64 are: *The Factory* (children are challenged to duplicate a machine part, using punch presses and other fabricating machine tools); *The Pond* (helps teach kids to gather information, make and test assumptions, recognize patterns and plan ahead while helping the frog reach the magic lily pad); *M-ss-ng-l-nks* (improves reading, writing, grammar and punctuation skills using text from children's classics); and *Challenge Math* (three math practice games in one package). Sunburst is also working on exciting new software compatible with Koala Technology's *Muppet Learning Keys*, a new add-on keyboard designed for children.

Sunburst's award-winning line of educational software.

American Educational Computer,
2450 Embarkadero Way, Palo Alto, CA 415-494-2021

AEC recently introduced educational programs for spelling (*AEC Spelling*) and (as additions to its *Matchmaker* series), *U.S. Government, World History, Biology, French*, and *Science I, II & III*.

AEC Spelling is a series of programs that teach the spelling of over 4,000 words, which encompasses over 98% of all written English, according to the manufacturer. Developed by Dr. Ruel Allred, a professor of education at Brigham Young University, for grades two through eight the programs boast a pretest that allows students to target only words that they need practice mastering. The program uses tried and true methods for studying words, including alphabetizing and identification of misspelled words in sentences.

Computerose, 2012 Randol Mill Road, Arlington, TX 76011
817-277-9153

Childpace is definitely one of the most original and innovative computer programs to enter the home market. In fact, the pediatrician I asked to evaluate *Childpace*, Rich Kotomori, who is also a 64 owner and mainstay of our local user group, whipped a copy of the Denver Developmental screening test out of his briefcase on the spot, when he realized what we had here. I asked him why a parent would need to administer this test.

He replied, "The tests that are given (by the parent using *Childpace*) follow the Denver Developmental Screening Test scale exactly and should give an accurate assessment of a child's development. At one time, assessing the development of a child was left up to the pediatrician in his (or her) office. However, often the parent is the best person to assess the development of a child. Now, if parents suspect a child is slow, they will be able to explain that in terms with which their pediatrician is familiar. This program will allow parents to give accurate information to their pediatrician and probably make it easier for the pediatrician to assess the child. I believe that the use of this program within the home will also cause the development of a closer parent-child relationship."

The *Childpace* instruction manual contains detailed instructions on administering the test and cautions (as Dr. Kotomori did) that children develop at different paces and test results serve only as a guideline for professional decisions. It includes a letter directed to the user's pediatrician explaining *Childpace*. *Childpace* was designed by physicians, educators and psychologists.

CBS Software, One Fawcett Place, Greenwich, CT 06836
203-622-2500

Sesame Street—a name to conjure in the minds and hearts of millions of American children and parents, comes to the Commodore 64 through the offices of CBS Software. Their five Sesame Street titles are: *Sesame Street Letter-Go-Round, Astro-Grover, Big Bird's Funhouse, Ernie's Magic Shapes* and *Big Bird's Special Delivery*. Included with each program is the EASYKEY vinyl keyboard overlay that makes it possible for children with no previous typing or computer experience to select options and answers using simple words and pictures. All look as interesting and educational as I would expect from the Children's Television Workshop's name, but I haven't had a chance to try them . . . yet!

The Sesame Street programs are by no means all that CBS has to offer. Indeed, they have a whole catalog of educational software that I'm sure they will send if you write and request it. One that looked very interesting was *The House that Jill Built* from Joyce Hakansson Associates. CBS also has SAT software and a host of other neat stuff.

Simon & Schuster Electronic Publishing,
1230 Avenue of the Americas, New York, NY 10020 212-245-6400

Simon & Schuster is a big book publishing company entering the software publishing business. Although they waited a bit longer than many other book publishers, they won't take long catching up, if what I saw at CES is any indicator. CBS software may have bagged Sesame Street but Simon & Schuster (along with others) plans on capturing the hearts and dollars of purchasers of educational software with programs featuring Jim Henson's Muppets.

Billed as combining the multimedia talents of Jim Henson Associates, the Muppet creators, and Joyce Hakansson Associates, one of the best known educational software design groups (CBS also markets Hakansson software), S&S announced a new series to be marketed under the name Muppet Institute of Technology. The first two titles in the series are *Kermit's Electronic Story Maker* and *The Great Gonzo in Word Rider*, which are both designed to increase a child's reading and English skills with an emphasis on creative writing.

The company also announced (surprise!) *Lovejoy's S.A.T.* and *College Preparation Guide*, from the authors of Lovejoy's College Club. They also market an excellent (I tried this one) typing program by Kriya Systems Inc., *Typing Tutor III*, designed for older students and adults. I lent it to a friend, who improved her typing speed to 75 wpm in less than an hour, after not typing since high school (I won't tell you how long ago that was!). C

FREE SOFTWARE

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Available for the Commodore Pet and Apple II + , IIe, IIc from us. Commodore is marketing the Commodore 64 version.

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Superb Support:

Commodore's Education Resource Centers

By Joseph A. Marlino
Commodore Education Marketing

The Commodore Education Resource Center Program is one of the most exciting and informative educational support programs available today. Currently over 400 Commodore-using schools are involved in the Resource Center program. These centers are located throughout the U.S. and Canada in elementary through graduate schools, computer camps and libraries.

The Commodore Education Resource Center Program was designed by the Education Department at Commodore and is believed to be the most efficient and effective way to support Commodore-using schools. The program is founded on the belief that the best educational support and assistance available comes from teachers and administrators helping each other. Commodore aids the Resource Centers in doing this support job by providing a quarterly information mailing, a free subscription to *Commodore Microcomputers* and most important, a telecommunications network.

The Resource Centers communicate with each other and the education staff at Commodore through the telecommunications network, ComEd. ComEd is accessed through the nationally known CompuServe Information Service. To aid in this, Commodore provides Resource Centers with a free VICMODEM and a free subscription to CompuServe. CompuServe has many SIG's (Special Interest Groups) ranging from specific hardware or software to cooking interests. ComEd is Commodore's Education SIG within CompuServe.

SIG's allow users to share ideas and communicate with other users who have the same interests. Every SIG has a SYSOP (system operator) whose function is to maintain the many messages and supervise the general flow of information within the specific SIG's topical guidelines. ComEd's SYSOP, a technical support representative, is based at Commodore corporate headquarters in West Chester, Pennsylvania.

A SIG's primary function is the exchange of information between one user and all other users. SIG's leave public messages for all users to see and comment upon through an electronic bulletin board which contains not only public announcements, but questions and responses too. This is the most frequently used SIG function.

By using the electronic bulletin board, the schools are able to transmit and receive messages across the U.S. and Canada only for the cost of calling the local access number in their area plus a special educational CompuServe hourly fee. This means of communication avoids lengthy postal delays and expensive long distance phone bills.

Another feature of ComEd and a second function of a SIG is its databases. In this area, Commodore Educational Resource Centers may archive files, programs, and other information for the mutual benefit of other resource centers, who can then access the database.

There are ten databases currently on ComEd. These databases contain files which many of our resource centers have found to be very informative. The databases are:

1. New products (hardware)
2. Software
3. Public domain software
4. Special programs for schools
5. Commodore Resource Centers
6. Commodore education dealers
7. School and home
8. LOGO
9. Technical questions and answers
10. Future - student database

Located on the databases are detailed files listing Commodore and third-party educational software programs. These programs are listed by subject (for instance, science, mathematics, classroom management) and age level and include a short description of the programs. There is also a file with the name, address and phone number of the software manufacturers, so educators can contact them after they identify the software they are interested in. In addition, new educational software packages are listed in a separate file, which is periodically updated.

How about some free software? One database on ComEd contains Commodore's educational public domain software series which can

be saved (downloaded) to your disk or tape with a proper smart terminal program. Other databases have files containing a list of Commodore education dealers, Commodore grant programs information, LOGO news and resources and a list of all Commodore's Education Resource Centers.

The list of Resource Centers can be very useful because it is coded according to the type and total count of Commodore computers owned by each center and has the address of each center. For example, this could be used by a school who needs to locate another school in the area who has a lab of SuperPETs. Information on curriculum, software, and so forth could then be shared by both schools so they could best utilize their machines.

The third major feature of a SIG is conferencing. Users may wish to schedule a live discussion on a specific subject. Once the date and time are agreed upon, all users enter the conference feature on the SIG. This is another valuable feature since it creates a classroom environment even when the users are thousands of miles apart.

Many resource centers are using their modems not only to take advantage of the many benefits of ComEd, but also to incorporate telecommunications into their curricula. Schools are using their modems to access current news events, stock quotes, the World Book Encyclopedia, computer simulations and many of the other information sources available on CompuServe and other information networks.

C

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Commodore's Continuing Commitment to the Education Market

By Patricia Walkington,
Manager, Commodore Education Marketing

Commodore hardware and software sales are on the increase in schools across the country as technology continues to penetrate every curriculum. Efforts are underway through state departments of education, colleges of education and local school districts to address the issues of comprehensive teacher training programs to ensure the success of computer-related instructional programs for students.

Recognizing that schools need assistance from industry, Commodore has invested millions of dollars in research and development to bring computers and computing to educators and their schools.

There is no question that students who become familiar with computers and programming early in their education have an incalculable advantage over those lacking computer experience. However, given the limits of many school budgets, it is often difficult for teachers and administrators to find the dollars they need to purchase computer systems and software packages in adequate numbers.

Commodore is committed to helping ensure that all children receive an equal opportunity to pursue computer literacy. The fact that Commodore 64 single systems, networks and stations require less than half the capital investment of comparable computer systems means a lot to schools and universities.

Commodore's education dealers provide support to schools in the form of training and service. Through the education dealers, a one-year warranty on equipment is provided to schools. It is important for schools to consider carefully how they want to use microcomputers before approaching an education dealer. Once the school district lists the uses of the computer, the dealer can then determine the appropriate package, including hardware, software, installation and warranty. Prices may be slightly higher than some of the mass merchandisers, but the schools are getting more than hardware—they are being provided an important support service. For a list of Commodore education dealers, please call our customer support number (215-431-9100, ext. 4200) or write to the education department here at Commodore.

At the state level, Commodore has launched a state department of education donation program called CREWS (Commodore Resources in Education With States). As encouragement to the efforts of state education departments to integrate microcomputers into education at the local level, CREWS will donate Commodore equipment to 20 states during the 1984 school year. Sixteen states have already received equipment donations thus far for their leadership role in assisting school districts with computer training, software selection and teaching strategies.

Commodore also sponsors a Matching Grant for Education Program. This program awards hardware donations to educational institutions that are developing innovative programs in teacher training and curriculum development using applications software or community education.

With more than 370 participants to date, Commodore has created Educational Resource Centers—a network of public and private schools and colleges using Commodore equipment. Each is linked to Commodore through a nationwide telecommunications network and agrees to share with others on the network information on computer software, as well as curriculum and teaching strategies.

In return, Commodore provides participants with a VICMODEM telecommunication access device, a subscription to the CompuServe Information Service and updated information on new products, educational support materials, school computer happenings, resources for decision making, LOGO and technical assistance.

More than 50 schools have been established as Commodore School Service Centers. Scattered across the country, these schools receive from Commodore, free of charge, training to service their equipment. Each school in this growing network can order repair and replacement parts directly from Commodore, improving the institution's self-reliance and computer efficiency.

Other educational support programs are currently under development as Commodore furthers its commitments to educators. We in education marketing will continue to keep you informed as new programs are launched. C

Commodore's Matching Grant Program

By Carroll McGillin
Commodore Education Marketing

During 1984, Commodore donated $1 million in hardware to outstanding educational computer programs as part of its Matching Grants Program targeted at educational institutions that are developing innovative programs which focus on teacher training and curriculum development using application software and community education.

Any equipment awarded for outstanding proposals has to be matched in kind by the school that receives the donation. To do this, schools have tapped all of the traditional funding sources such as department and audio-visual budgets, as well as some that call for real community support. Take, for instance, the Canaan/Enfield Elementary schools in New Hampshire. "Cans for Computers" is the slogan for the student-run Cans for Computers Recycling Corporation that this rural five-town school district inaugurated. Since September, 1983, kids and parents have collected 20,000 pounds of aluminum cans worth $6,000 towards a goal of $10,000 to be used with Federal Block Grant money to match the hardware donation they received from Commodore.

In this first year of the program, over 600 schools nationwide submitted proposals. Each school interested in the Matching Grant Program was sent a proposal form in which they described the following aspects of their program:

—the educational need being targeted.
—how the program would meet the stated educational need.
—the activities by which the program will reach the objectives.
—a strategy for evaluating the effectiveness of the program
—a method for disseminating the results of the program within the school district, Commodore and the larger educational community
—a list of hardware needed for the program.

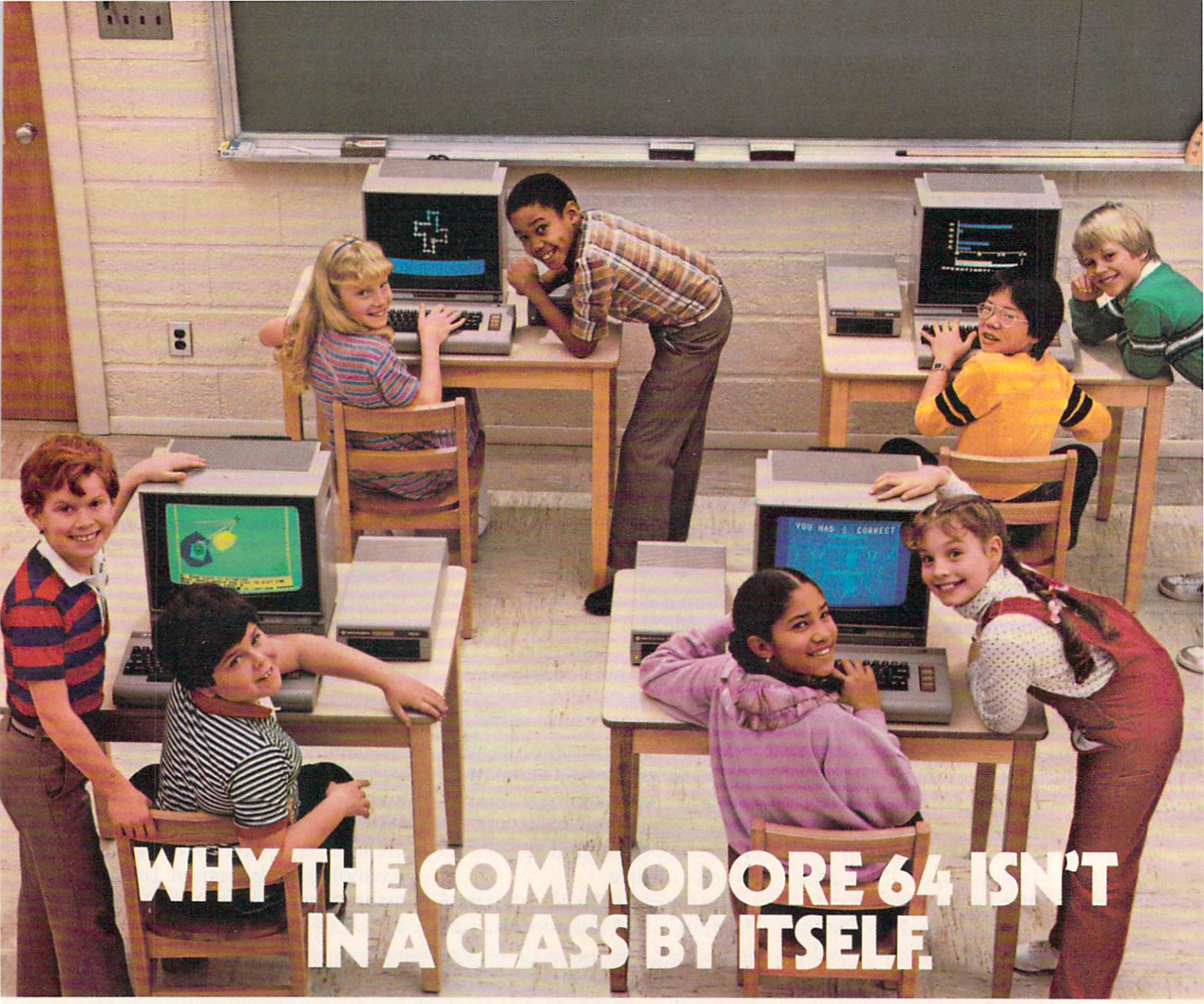
During March, each proposal was reviewed by four teams of educators representing a wide range of computer education experience from kindergarten through college.

The biggest difficulty with the Matching Grant Program this past year was hearing about so many educational institutions that have developed some very exciting computer applications and being able to fund only 80 of these programs. The matching grants were awarded this past April. New proposal guidelines were sent out in early September. If you would like to receive an application and guidelines, please contact me at Commodore's corporate headquarters. Commodore began this Matching Grant Program because we believe that by working in partnership with the educational community, we will come a long way in utilizing the productive and creative capabilities of computer technology in education. Looking at the grant recipients for 1984, we are off to a good start!

Some of the Matching Grant Winners for 1984

- A mobile lab for teacher training in rural Vermont.
- In Virginia, a writing skills program for junior-senior high students with learning disabilities.
- A computer-lending library for families in Arkansas.
- Remedial skills program for fourth graders in Midway, California.
- At the University of Florida, Gainesville, a training program for undergraduate and graduate art education majors to utilize the computer as an art medium.
- Developing software materials for math survival skills to enhance the learning of autistic students.
- Establishing computer labs in order to develop a standardized, self-paced, open-entry, open-exit computer-assisted instruction for a California GED program.
- Developing an individualized writing skills program for migrant students at Fredonia State College in New York.
- A math lab for orthopedically handicapped students utilizing the mathematical skill capabilities of LOGO and the robotic turtle.
- A computer literacy lab in Lakewood, Ohio, to instruct students in the use of the computer as a tool for problem solving, database management and word processing.

Want to find out more about some of these programs? Starting in September, there will be an electronic bulletin board on the ComEd telecommunications network where grant recipients and all Commodore-using schools can share ideas about their programs. (For more about ComEd, see Joe Marlino's article on page 96.) C



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The Microcomputer: Revitalizing Education

By Daniel W. Kunz

Director, Commodore Educational Software

During the last few years, educators have wrestled with a new tool of instruction—the microcomputer—in order to find the best adaptation of the computer's power and flexibility within the school's curriculum. As with any major innovation, particularly a technological one, these efforts have met with mixed success.

If these efforts failed, it was usually not due to the teacher's inability to use the hardware nor the teacher's or the school's lack of interest. A primary reason for some of these failures has been a lack of appropriate in-service training which would help the teacher learn how to integrate the computer and the software into the day-to-day classroom curriculum.

Computer Literacy

Teaching computer awareness is more than teaching someone about the value of the computer in society. We need to avoid a situation like that which occurred in the earlier part of the century when radios were first starting to appear in homes. At that time, curricula were developed at the state and national levels for teaching about the implications of radio. Five years later, about the time the curricula were being made widely available, radio was already an accepted part of life. The same mistake was repeated when television and calculators were introduced. The microcomputer, within five years, will be an accepted part of almost everyone's life. Let us not repeat past mistakes.

The teaching of programming, as a form of computer literacy misses the mark. There is presently a trend to use programming as a method of making students computer literate. It is assumed that all the students involved will benefit by learning critical and logical thinking skills. Unfortunately, the problem is that many, if not most, of these courses are not taught from a critical thinking/problem-solving perspective.

For example, there is no question that the teaching of geometry can stimulate logical thought processes and decision-making and critical-thinking skills. Unfortunately, many geometry courses in this country are not taught that way. The issue is the method of instruction, not the content. Even if a programming course is taught from a problem-solving perspective, the automatic transfer of higher level cognitive skills from one activity to another that is assumed does not always take place.

The technique of using programming to improve critical thinking and decision-making/problem-solving skills is viable. It has been the implementation of that strategy that has been severely lacking.

In addition, there has been considerable discussion recently about the longevity of BASIC, particularly in business and professional applications. Therefore, if we are training students to program in a language they are not likely to use when they get out of school and if most of these courses are not taught from a critical- thinking or problem-solving perspective, then what exactly is being accomplished?

The most salient argument, however, is one of learning style. We frequently assume that all students can learn everything all the time. Up to some degree, the purists would argue that this is true. As a pragmatist, I think that is not realistic. Some students will, in fact, have a facility with programming; others will not. To try and force a large percentage of students into programming courses will most likely not be successful. Not all students are able to, or wish to, understand the logical processes necessary for facility with programming.

We use different teaching strategies because not all students learn in the same way and we allow students to take electives because not everyone needs to know the same information. We have grades and tracks because differentiation of learning is considered necessary and in fact, desirable.

If a school requires programming courses, the school should very carefully look at the course structure to be sure that the critical-thinking and problem-solving skills are highlighted. This critical review will help ensure that the student is learning to use the microcomputer and programming as tools for acquiring more broad-based skills.

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graphing, as well as the use of telecommunications, are the kinds of applications that students are very likely to encounter regardless of the type of work they do. The ability to use business or productivity software will in the near future be one of the primary definitions of computer literacy.

The Computer as a Tool

The computer used as a tool of instruction is particularly adaptable to many modes of instruction. Overall, it is arguable that the computer may be the single tool best suited to all modes of instruction.

The first mode of instruction is drill and practice. The drill and practice mode supports information already provided by the teacher; it allows the students to review the information at their own pace.

In this case, the micro can be a simple tool for individualized instruction. A higher level of individualization can be attained by using computer tutorials in which the computer, rather than just solving a problem or giving an answer, actually allows the student to work through correct responses, tutoring the student and using branching capabilities to guide the student toward the correct response. This tutorial approach can very easily be used to support small and large group instruction.

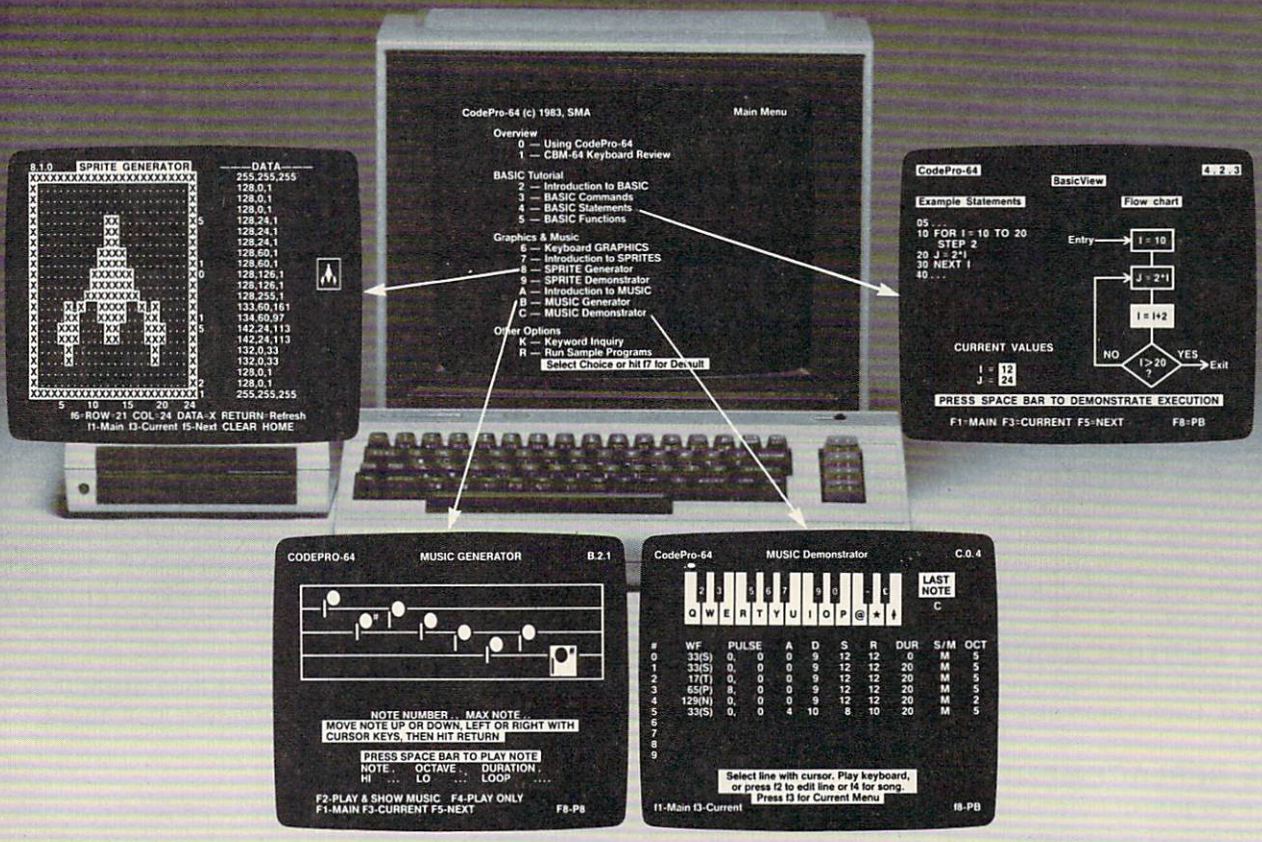
Another instruction mode is simulation. The concept is that a simulation helps develop critical-thinking and problem-solving skills. The question is, does asimulation alone really accomplish this?

To have the maximum effect, a computer simulation or open-ended software activity requires a teacher, knowledgeable in the techniques of inquiry, strategy and discovery, to set the stage and work with the student through the setup and preliminary exploration, to maintain the student's interest during the activity and to provide appropriate post-session activities, questions and guidance so that the learning can be maximized, continued and then applied to other situations. This is no small task!

None of the above teaching strategies happen automatically. They all require significant skill on the part of the teacher. True individualization, inquiry and discovery strategies are possibly the most difficult strategies for a teacher to master. Ineffectively used, they are no better than talking at the students. Effectively mastered, they can improve the child's critical thinking, logical processing and decision-making skills. The micro can be an excellent tool in assisting a good teacher to help the student acquire or improve these skills. But it can in no way *replace* that teacher.

I suggest that the computer be thought of as a tool of instruction—no more, no less. It can be a powerful tool when used by an effective teacher with the appropriate software keyed to the right teaching strategy.

I, therefore, believe the most critical issue facing schools at the moment is the need to improve teachers' abilities to effectively use the various modes of instruction and to be able to select and use the best tools for each mode. As this occurs, teachers will integrate microcomputers into the classroom curriculum and they will be able to select the software that is appropriate for their teaching style, the learning style of their students and for the concepts they are trying to teach. From careful planning, selection and execution comes learning. C



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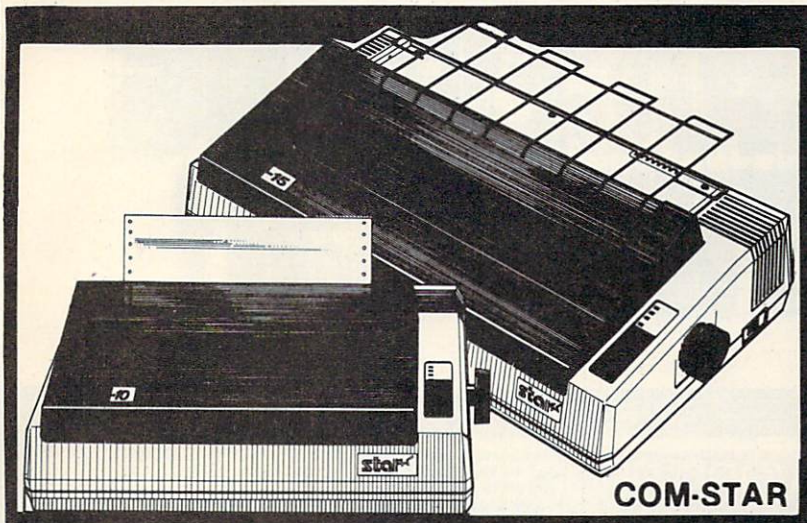

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USRCMD  $032C-032D    812-813
ILOAD   $032E-032F    814-815
ISAVE   $0330-0331    816-817        Savesp

TAPBUF  $0333-03F2    819-1010       Cassette tape buffer
WRLEN   $03F3-03F4    1011-1012      Length of data to be written to tape
RDCNT   $03F5-03F6    1013-1014      Length of data to be read from tape

INPQUE  $03F7-0436    1015-1078      RS-232 input queue
ESTAKL  $0437-0454    1079-1108
ESTAKH  $0455-0472    1109-1138

CHRGET  $0473-0478    1139-1144
CHRGOT  $0479-0484    1145-1156
QNUM    $0485-0493    1157-1171

INDSUB  $0494-04A1    1172-1185      Shared ROM fetch sub
ZERO    $04A2-04A4    1186-1188      Numeric constant for Basic

INDTXT  $04A5-04AF    1189-1199      Txtptr
INDIN1  $04B0-04BA    1200-1210      Index & Index1
INDIN2  $04BB-04C5    1211-1221      Index2
INDST1  $04C6-04D0    1222-1232      Strng1
INDLOW  $04D1-04DB    1233-1243      Lowtr
INDFMO  $04DC-04E6    1244-1254      Facmo

PUFILL  $04E7         1255           Print using fill symbol
PUCOMA  $04E8         1256           Print using comma symbol
PUDOT   $04E9         1257           Print using D.P. symbol
PUMONY  $04EA         1258           Print using monetary symbol

TMPDES  $04EB-04EE    1259-1262      Temp for instr
ERRNUM  $04EF         1263           Last error number
ERRLIN  $04F0-04F1    1264-1265      Line #of last error
TRAPNO  $04F2-04F3    1266-1267      Line to go on error
TMPTRP  $04F4         1268           Hold trap no. temporarily
ERRTXT  $04F5-04F6    1269-1270
OLDSTK  $04F7         1271

TMPTXT  $04F8-04F9    1272-1273
TMPLIN  $04FA-04FB    1274-1275

MTIMLO  $04FC-04FD    1276-1277      Table of pending jiffies (2's comp)
MTIMHI  $04FE-04FF    1278-1279
USRPOK  $0500-0502    1280-1282
RNDX    $0503-0507    1283-1287
DEJAVU  $0508         1288           'cold' or 'warm' start status

LAT     $0509-0512    1289-1298      Logical file numbers
FAT     $0513-051C    1299-1308      Primary device numbers
SAT     $051D-0526    1309-1318      Secondary addresses

KEYD    $0527-0530    1319-1328      IRQ keyboard buffer
MEMSTR  $0531-0532    1329-1330      Start of memory
```

```
MSIZ    $0533-0534   1331-1332      Top of memory
TIMOUT  $0535        1333           IEEE timeout flag

FILEND  $0536        1334           File end reached =1, 0 otherwise
CTALLY  $0537        1335           #of chars left in buffer (for R&W)
CBUFVA  $0538        1336           #of total valid chars in buffer (R)
TPTR    $0539        1337           Ptr to next char in buffer (for R&W)
FLTYPE  $053A        1338           Contains type of current cass file

COLOR   $053B        1339           Active attribute byte
FLASH   $053C        1340           Character flash flag
        $053D        1341           FREE
HIBASE  $053E        1342           Base location of screen (top)
XMAX    $053F        1343
RPTFLG  $0540        1344           Key repeat flag
KOUNT   $0541        1345
DELAY   $0542        1346
SHFLAG  $0543        1347           Shift flag byte
LSTSHF  $0544        1348           Last shift pattern
KEYLOG  $0545-0546   1349-1350      Indirect for keyboard table setup
MODE    $0547        1351
AUTODN  $0548        1352           Auto scroll down flag (0=on,0<>off)
LINTMP  $0549        1353
ROLFLG  $054A        1354

FORMAT  $054B        1355           Monitor non-zpage  storage
MSAL    $054C-054E   1356-1358
WRAP    $054F        1359
TMPC    $0550        1360
DIFF    $0551        1361
PCH     $0552        1362
PCL     $0553        1363
FLGS    $0554        1364
ACC     $0555        1365
XR      $0556        1366
YR      $0557        1367
SP      $0558        1368
INVL    $0559        1369
INVH    $055A        1370
CMPFLG  $055B        1371           Used by various monitor routines
BAD     $055C        1372

KYNDX   $055D        1373           Used for programmable keys
KEYIDX  $055E        1374
KEYBUF  $055F-0566   1375-1382      Table of P.F. lengths
PKYBUF  $0567-05E6   1383-1510      P.F. key storage area

KDATA   $05E7        1511           Temp for data write to kennedy
KDYCMD  $05E8        1512           Select for kennedy read or write
KDYNUM  $05E9        1513           Kennedy's dev#
KDYPRS  $05EA        1514           Kennedy present = $ff,else=$00
KDYTYP  $05EB        1515           Temp for type of open for kennedy


SAVRAM  $05EC-06EB   1516-1771    1 page used by banking routines
PAT     $05EC-05EF   1516-1519    Physical Address Table
LNGJMP  $05F0-05F1   1520-1521    Long jump address
FETARG  $05F2        1522         Long jump accumulator
FETXRG  $05F3        1523         Long jump x register
FETSRG  $05F4        1524         Long jump status register

AREAS   $05F5-065D   1525-1629    RAM areas for banking

ASPECH  $065E-06EB   1630-1771    RAM area for speech

STKTOP  $06EC-07AF   1772-1967    BASIC run-time stack

WROUT   $07B0        1968         Byte to be written on tape
PARITY  $07B1        1969         Temp for parity calc
```

(Continued On Page 110)

(Continued From Page 109)

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TT1       $07B2          1970          Temp for write-header
TT2       $07B3          1971          Temp for write-header
RDBITS    $07B5          1973          Local index for READBYTE routine
ERRSP     $07B6          1974          Pointer into the error stack
FPERRS    $07B7          1975          Number of first pass errors

DSAMP1    $07B8-07B9     1976-1977     Time constant
DSAMP2    $07BA-07BB     1978-1979     Time constant
ZCELL     $07BC-07BD     1980-1981     Time constant

SRECOV    $07BE          1982          Stack marker for stopkey recover
DRECOV    $07BF          1983          Stack marker for dropkey recover
TRSAVE    $07C0-07C3     1984-1987     params passed to RDBLOK
RDETMP    $07C4          1988          Temp stat save for RDBLOK
LDRSCN    $07C5          1989          # consec shorts to find in leader
CDERRM    $07C6          1990          # Errors fatal in RD countdown
VSAVE     $07C7          1991          Temp for Verify command
T1PIPE    $07C8-07CB     1992-1995     Pipe temp for T1
ENEXT     $07CC          1996          Read error propagate

                                       FOR RS-232
UOUTQ     $07CD          1997          User character to send
UOUTFG    $07CE          1998          0=empty ; 1=full
SOUTQ     $07CF          1999          System character to send
SOUNFG    $07D0          2000          0=empty ; 1=full
INQFPT    $07D1          2001          Pntr to front of input queue
INQRPT    $07D2          2002          Pntr to rear of input queue
INQCNT    $07D3          2003          # of chars in input queue
ASTAT     $07D4          2004          Temp status for ACIA
AINTMP    $07D5          2005          Temp for input routine
ALSTOP    $07D6          2006          FLG for local pause
ARSTOP    $07D7          2007          FLG for remote pause
APRES     $07D8          2008          FLG to indicate presence of ACIA

KLUDES    $07D9-07E4     2009-2020     Indirect routine downloaded
SCBOT     $07E5          2021
SCTOP     $07E6          2022
SCLF      $07E7          2023
SCRT      $07E8          2024
SCRDIS    $07E9          2025
INSFLG    $07EA          2026
LSTCHR    $07EB          2027
LOGSCR    $07EC          2028
TCOLOR    $07ED          2029
BITABL    $07EE-07F1     2030-2033

SAREG     $07F2          2034          Registers for SYS command
SXREG     $07F3          2035
SYREG     $07F4          2036
SPREG     $07F5          2037

LSTX      $07F6          2038          Key scan index
STPDSB    $07F7          2039          Flag to disable CTL-S pause
RAMROM    $07F8          2040          MSB for monitor fetches from ROM=0;RAM=1
COLSW     $07F9          2041          MSB for color/lim table in RAM=0;ROM=1
FFRMSK    $07FA          2042          ROM mask for split screen
VMBMSK    $07FB          2043          VM base mask for split screen
LSEM      $07FC          2044          Motor lock semaphore for cassette
PALCNT    $07FD          2045          PAL tod

TEDATR    $0800-0BFF     2048-3071     TED attribute bytes

TEDSCN    $0C00-0FFF     3072-4095     TED character pointers

BASBGN    $1000-         4096-         Start of BASIC text area

BMLUM     $1800-$1BFF    6144-7167     Luminance for bit map screen

BMCOLR    $1C00-1FFF     7168-8191     Color for bit map
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(Continued on page 112)

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```
GRBASE  $2000-      8192-        Start of bit map screen data

GRBASE  $4000-      16384-       Start of BASIC when HIRES is on
                                 (in 64K machine only)

CHRBAS  $D000       53248        Beginning of character ROM data
                TExt Display (TED) Chip


$FF00       65280       Timer #1 reload value,
                        bits 0-7 (low)

$FF01       65281       Timer #1 reload value,
                        bits 8-15 (high)

$FF02       65282       Timer #2 reload value,
                        bits 0-7 (low)

$FF03       65283       Timer #2 reload value,
                        bits 8-15 (high)

$FF04       65284       Timer #3 reload value,
                        bits 0-7 (low)

$FF05       65285       Timer #3 reload value,
                        bits 8-15 (high)

$FF06       65286       Bits 0-2 : screen vertical offset
                        Bit 3    : 24 or 25 rows
                        Bit 4    : Screen blank
                        Bit 6    : Extended color mode
                        Bit 5    : Bit map mode
                        Bit 7    : TEST

$FF07       65287       Bits 0-2 : horizontal offset
                        Bit 3    : 38 or 40 columns
                        Bit 4    : Multicolor mode
                        Bit 5    : Freeze
                        Bit 6    : NTSC/PAL
                        Bit 7    : Hardware reverse

$FF08       65288       Keyboard latch

$FF09       65289       Interrupt (IRQ) flags
                        Bit 0    : unused
                        Bit 1    : Raster
                        Bit 2    : Light pen
                        Bit 3    : Timer #1
                        Bit 4    : Timer #2
                        Bit 5    : unused
                        Bit 6    : Timer #3
                        Bit 7    : Interrupt flag

$FF0A       65290       Interrupt enable register
                        Bit 0    : Bit 8 raster interrupt set
                        Bit 1    : Raster
                        Bit 2    : Light pen
                        Bit 3    : Timer #1
                        Bit 4    : Timer #2
                        Bit 5    : unused
                        Bit 6    : Timer #3
                        Bit 7    : unused

$FF0B       65291       Raster interrupt set, bits 0-7

$FF0C       65292       Hardware cursor position, bits 8 & 9
                        (bit 0 is bit 8, bit 1 is bit 9)

$FF0D       65293       Hardware cursor position, bits 0-7
```

(Continued on page 114)

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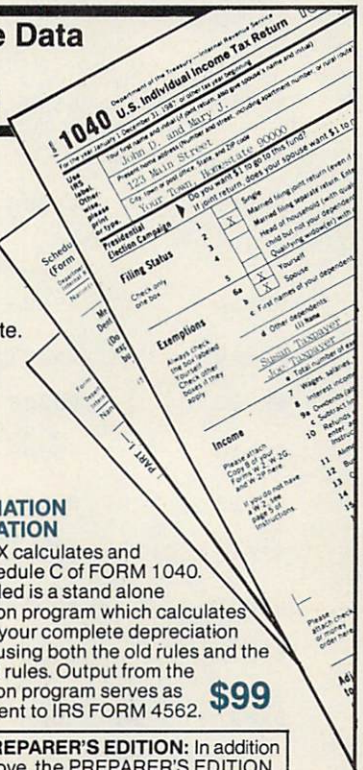

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Memory Map *(Continued from page 112)*

```
$FF0E        65294        Voice #1 frequency, bits 0-7

$FF0F        65295        Voice #2 frequency, bits 0-7

$FF10        65296        Voice #2 frequency, bits 8 & 9
                          (bit 0 is bit 8, bit 1 is bit 9)

$FF11        65297        Bits 0-3 : Volume control
                          Bit 4    : Voice #1 select
                          Bit 5    : Voice #2 select
                          Bit 6    : Voice #2 noise select
                          Bit 7    : Sound reload

$FF12        65298        Bit 0-1  : Voice #1 frequency, bits 8 & 9
                          Bit 2    : TED data fetch ROM/RAM select
                          Bits 0-5 : Bit map base address

$FF13        65299        Bit 0    : Clock status
                          Bit 1    : Set single clock
                          Bits 2-7 : Character data base address

$FF14        65300        Bits 3-7 : Video matrix/color memory
                                      base address

$FF15        65301        Background color register
                          Bits 0-3 : Color
                          Bits 4-6 : Luminance

$FF16        65302        Color register #1
                          Bits 0-3 : Color
                          Bits 4-6 : Luminance

$FF17        65303        Color register #2
                          Bits 0-3 : Color
                          Bits 4-6 : Luminance

$FF18        65304        Color register #3
                          Bits 0-3 : Color
                          Bits 4-6 : Luminance

$FF19        65305        Color register #4
                          Bits 0-3 : Color
                          Bits 4-6 : Luminance

$FF1A        65306        Bit map reload

$FF1B        65307        Bit map reload

$FF1C        65308        Bit 0    : Vertical line bit 8

$FF1D        65309        Bits 0-7 : Vertical line bits 0-7

$FF1E        65310        Horizontal position

$FF1F        65311        Blink, vertical sub address

$FF3E        65342        ROM select

$FF3F        65343        RAM select

BANKING JUMP TABLE

        $FCF1      64753        JMP to cartridge IRQ routine
        $FCF4      64756        JMP to PHOENIX routine
        $FCF7      64759        JMP to LONG FETCH routine
        $FCFA      64762        JMP to LONG JUMP routine
        $FCFD      64765        JMP to LONG IRQ routine
```

(Continued on page 116)

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For Commodore 64™ **Personal Comments** by Jim Gracely, Technical Editor, Commodore Magazine

IEA Instant Editor Assembler

The IEA Instant Editor Assembler package is an invaluable asset to the beginning machine language programmer. The package contains an excellent editor/assembler system, a full featured monitor and a walk program with variable step speed and the ability to add break points. All three of these programs may be resident in memory at the same time. The individual programs are easy to understand, easy to use and work quickly and efficiently.

The package as a whole is quite professionally written. The Disk which contains the main programs also contains six programs assisting in the use of these programs and more than a dozen additional utility and example programs. One additional feature of the manual is a technical assistance number to aid you with any problems or questions you might have.

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```
UNOFFICIAL JUMP TABLE
        $FF49       65353       JMP to define function key routine
        $FF4C       65356       JMP to PRINT routine
        $FF4F       65359       JMP to PRIMM routine
        $FF52       65362       JMP to ENTRY routine

        $FF80       65408       RELEASE # OF KERNAL (msb 0=NTSC;1=PAL)

KERNAL JUMP TABLE

  NAME      ADDRESS               DESCRIPTION
  ------------------------------------------------------------------
  CINT      $FF81    65409        Initialize screen editor
  IOINIT    $FF84    65412        Initialize I/O devices
  RAMTAS    $FF87    65415        Ram test
  RESTOR    $FF8A    65418        Restore vectors to initial values
  VECTOR    $FF8D    65421        Change vectors for user
  SETMSG    $FF90    65424        Control O.S. messages
  SECND     $FF93    65427        Send SA after LISTEN
  TKSA      $FF96    65430        Send SA after TALK
  MEMTOP    $FF99    65433        Set/Read top of memory
  MEMBOT    $FF9C    65436        Set/Read bottom of memory
  SCNKEY    $FF9F    65439        Scan keyboard
  SETTMO    $FFA2    65442        Set timeout in DMA disk
  ACPTR     $FFA5    65445        Handshake serial bus or DMA disk byte in
  CIOUT     $FFA8    65448        Handshake serial bus or DMA disk byte out
  UNTLK     $FFAB    65451        Send UNTALK out serial bus or DMA disk
  UNLSN     $FFAE    65454        Send UNLISTEN out serial bus or DMA disk
  LISTN     $FFB1    65457        Send LISTEN out serial bus or DMA disk
  TALK      $FFB4    65460        Send TALK out serial bus or DMA disk
  READSS    $FFB7    65463        Return I/O STATUS byte
  SETLFS    $FFBA    65466        Set LA, FA, SA
  SETNAM    $FFBD    65469        Set length and FN address
  OPEN      $FFC0    65472        Open logical file
  CLOSE     $FFC3    65475        Close logical file
  CHKIN     $FFC6    65478        Open channel in
  CHOUT     $FFC9    65481        Open channel out
  CLRCH     $FFCC    65484        Close I/O channels
  BASIN     $FFCF    65487        Input from channel
  BSOUT     $FFD2    65490        Output to channel
  LOADSP    $FFD5    65493        Load from file
  SAVESP    $FFD8    65496        Save to file
  SETTIM    $FFDB    65499        Set internal clock
  RDTIM     $FFDE    65502        Read internal clock
  STOP      $FFE1    65505        Scan STOP key
  GETIN     $FFE4    65508        Get character from queue
  CLALL     $FFE7    65511        Close all files
  UDTIM     $FFEA    65514        Increment clock
  SCRORG    $FFED    65517        Screen org.
  PLOT      $FFF0    65520        Read/Set X,Y coord of cursor
  IOBASE    $FFF3    65523        Return location of start of I/O
```

C

For The C64

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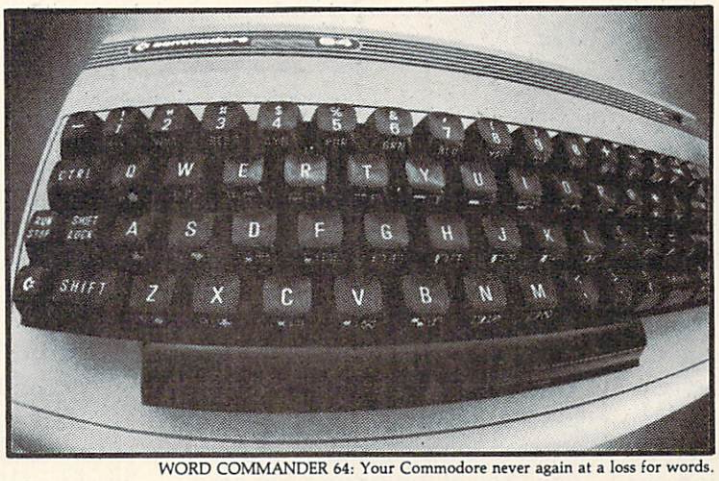

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BBS Systems:

The Ultimate Self-Help Network?

By Deepak Midha

It seems as if everyone has heard about hackers and online bulletin board systems (BBS), thanks to the dramatic news about people who break into other people's computer systems and the movie "War Games". This article and the columns in subsequent issues will try to tell you the real story behind hackers and bulletin board systems, covering not only the Commodore Information Network, but small bulletin boards being run by local enthusiasts.

Since we will be covering Commodore Information Network events in CompuServe's Consumer Information Service and also what is happening on other networks and local BBS Systems, if you run a local BBS System, send me news on CompuServe via EMAIL. My ID is 70007,574.

Hackers are often portrayed as crazed computer owners who enjoy calling phone numbers at random and finding computer systems to break into in order to do untold damage. This is far from the truth. There are a number of vandals who do this and they are usually despised by the real hacker community. Real hackers are ordinary people who have one thing in common—they enjoy using their home computers for everything from cataloging videotapes to exploring the way computers work.

The crackers or phreakers (which are much more descriptive names) are just like any other vandal; they ignore the rules of good behavior. This column will contain occasional references to these vandals, but will mainly concern itself with the majority of responsible users of home computers.

What is a Local Bulletin Board System (BBS)?

A BBS is a computerized message board with various sections for leaving messages for other users and receiving replies. These messages are usually public and any user of the system can read them, although some systems also support private messages and electronic mail (EMAIL), which can be read only by the addressee or the sysop (system operator).

Some BBS systems allow you to upload and download programs for your computer. This is done using various techniques (these techniques are called protocols—which are a defined method of communication).

The simplest downloading technique is the buffer capture protocol, in which you open the buffer in your terminal program and capture what is sent to you. You can then save this buffer on disk or print it. If it is a BASIC program, you will have to convert it into tokenized or internal form to run it. Machine language programs, however, usually require you to use a more sophisticated protocol like XMODEM or B protocol.

A local BBS can be run on a variety of home computers ranging from the VIC 20 to a large IBM PC. It requires special software and an auto-answer modem, which can answer the phone under program control. Software for running a BBS can be free (there are some programs in the databases of the Commodore Information Network and others may be downloaded from other BBS systems) or can cost up to $150 from professional publishers.

Who Runs Bulletin Board Systems?

The majority of BBS's are run by individual hobbyists, although many of the newer ones are being set up and supported by user groups. In fact, some user groups are setting up more than one to handle different services—one for messaging, another for downloading and so on. The essential simplicity of setting up a BBS system allows almost anyone with a home computer, disk drive and auto-answer modem to connect it to a telephone line and become an instant sysop.

I am considering using a modified version of a BBS program as a messaging center for my friends and clients who have computers. It will do away with incomprehensible messages on my answering machine and scribbled (and equally incomprehensible) notes from my wife. If you have a modem and a suitable terminal program, try contacting your local BBS—it will surprise you.

A number of computer stores have recently set up BBS's for their customers. These systems allow all the normal BBS functions, but additionally carry all or part of the store catalog and offer discounted prices to BBS users. Currently, this appears to be restricted to computer stores, but I expect tc

see other stores start using BBS systems as a marketing tool in the near future.

What Kind of Information is Carried on a BBS?

Local BBS's carry discussions and news on many subjects, from information on the availability of software (some even carry discount catalogs and allow online ordering of products) to lists of local events. Some are dedicated to other hobbies like photography or ham radio and can supply you with information about these topics. Some sysops are even carrying news bulletins and weather forecasts rewritten from radio or television. In fact, a BBS can be used for almost any purpose.

The real power of BBS systems is that they give you access to the other hackers in the world. Most of them (including me) are addicted to being online to something: a local BBS, CompuServe, The Source or even MCI Mail. They can help you learn about your computer for nothing more than the cost of a phone call (using your local BBS). They are a resource that cannot be found in a magazine or book.

These are the people who can make your computer do things that the manufacturer doesn't believe possible. These are the ones who make the SID chip in your 64 talk, sing and sound like an orchestra. If you want to know how to do something, just ask and they will tell you. In the early days with my 64, the friendly hackers on the Commodore Information Network saved me untold hours of wasted effort and I am pleased to be able to return the favor by helping others now as a sysop.

If you are feeling a little lost with your computer and are tempted to put it away in a cupboard, wait. Try out your local BBS and user group to find out what other people are doing. Sign up for CompuServe (remember that

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free hour ID that came with the modem? Use it now!) and look up the Commodore Information Network. Twenty thousand other people did and are getting help and access to a vast library of programs that can be downloaded from the databases. The CIN contains everything from adventure games to zoology drills and has something that a local BBS doesn't have—an online conference area that allows you to talk in real time with other users.

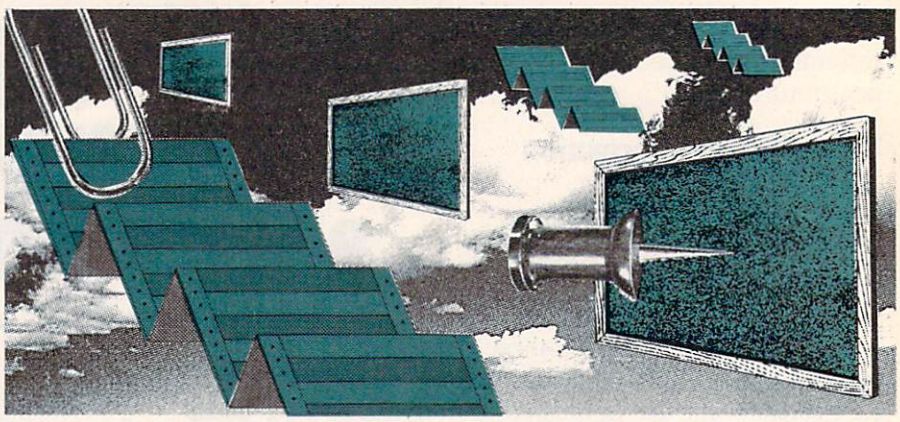
How Many BBS's Are There?

No one knows just how many local BBS's there are in the United States or Canada and estimates vary from 4,000 to more than 7,000. Lists of local BBS access numbers tend to be obsolete as soon as they are published since some cease operating as new ones begin. A local BBS will usually carry a list of other BBS systems in the local area.

The major networks, The Source and CompuServe, both have Commodore-oriented discussion forums, although only the Commodore Information Network on CompuServe is officially supported by Commodore. The Commodore Information Network is probably the largest single source of information for Commodore computer owners anywhere outside Commodore itself. The new regional networks will set up Commodore-oriented groups as they get organized.

The Commodore Information Network

The Commodore Information Network has members who can answer almost any conceivable question about your Commodore computer (and some non-Commodore computers, also). To join, simply use the free hour signup kit that came with your modem or buy a signup kit from your dealer or mass merchandisers like K-Mart or Toys-R-Us. Read the "Survival



Kit" and try some of the bulletin boards, which are also called SIG's—special interest groups. There, the sysops, along with thousands of other members, will try to help you get the best out of your computer system.

There are currently three SIG's in the Commodore Information Network: a Commodore 64 SIG devoted to the Commodore 64, a CBM programming SIG which covers the more advanced aspects of programming for all Commodore computers and a SIG which covers the VIC 20 and other Commodore computers. There are plans for more SIG's later this year, including one for artistic pursuits and a special beginners' SIG where new owners can find answers to all their questions without feeling lost.

Currently there are sections in the SIG's covering telecommunications, COMAL, disk programming, CP/M, FORTH, and utility programming. There are also two databases containing public domain software for the 64. Members have uploaded many programs including a four-minute 1541 copy utility, a replacement for the 1541 DOS wedge that includes additional BASIC commands like FIND, CHANGE, DELETE and (RE) number. This makes programming the 64 much easier. In addition, a "disk doctor" utility available here allows you to recover bad disks. There is also an entire database devoted to games for the 64, many of which use the 64's full range of graphics and sound capabilities. A number of members have also written and uploaded music programs that use the full range of the SID chip. These programs are uploaded with the complete program so you can see how it was done.

The conference area allows you to talk via your computer to other users all over the North American continent and even an occasional user from Europe (via the international networks). The conference area is also used for formal conferences on important topics. Sysop deb! Christensen also runs BASIC classes for beginners in the conference area. These have helped many users get started.

By the time this column is published, we will have conducted our first beginner's conference, which will have been run in two parts. The first part, an online play called "Alvin the Lost in CIN", is about a new user getting lost in the system and being helped out by Supersysop. We will hold more of these conferences on a regular basis, so look for them.

Don't get the impression that everything that happens online is in total seriousness. We have messages running on the board about trivia questions and now have a trivia column in our online newsletter "The Sixty-Fourth Dimension". The current issue also contains reviews of commercial software and some humorous articles.

In our conference area, people

use handles to identify themselves. When you join, look for RETURN, Bob&Kate (sometimes b&k), *Sweetheart*, CZ Wing, Curly & Spot, JMcA, Maud'ib, CZ Wing, Kerry, Silvermane, Jester, <<Ellen>>, Micro and <SAHIB>.

What Does It Cost?

BBS systems, whether large (like CompuServe) or small (like your local BBS), are an incredible way to talk to others who can help you. For your local BBS, the only cost is the price of your phone call and if you have extended area service, that could mean no real cost other than fighting with your family for access to the phone!

Commercial networks are more expensive and usually charge for the length of time that you are online. This can vary from $6-25 an hour to as much as $65 an hour. There can be surcharges added for using other services within the network, so be very careful to read any instructions and price lists before you access any premium services.

Try It Out—Let Me Know

Since BBS systems are primarily for member-to-member discussions, they tend to contain more accurate information than is generally available in publications. When an enthusiast solves a problem, he loves to broadcast the solution. In this way, most BBS systems contain answers to complex as well as simple problems.

Try your local BBS system and let me know how you make out, by sending me a letter via the magazine, by EMAIL to 70007,574 on CompuServe or by MCI MAIL to DEEPAKMIDHA. I will publish the best anecdotes here.

I hope to meet some of you in the Commodore Information Network over the coming months and hope that you will find this column helpful in using your Commodore computers. C

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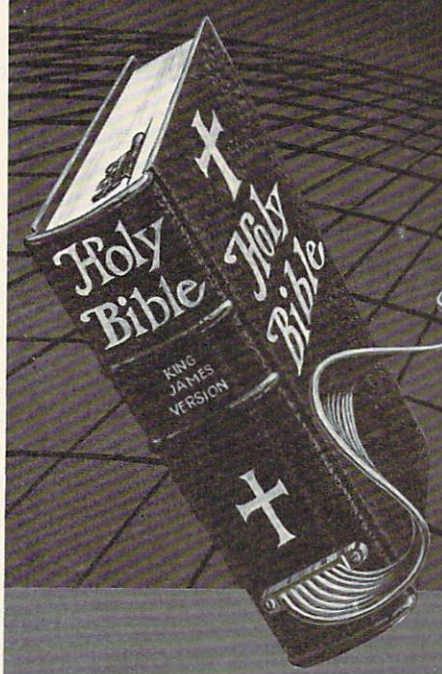

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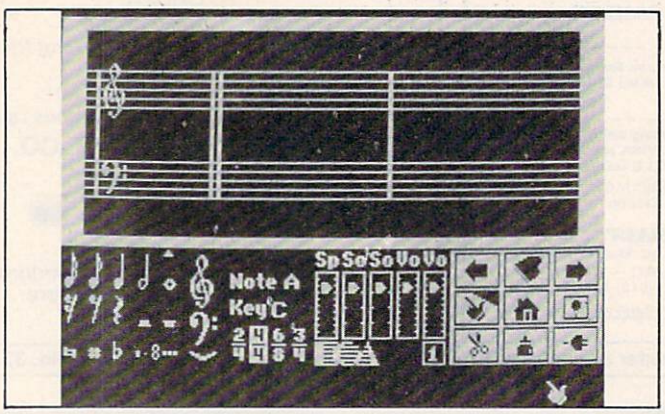
Music Construction Set

Reviewed by Ted Salamone

Computer: Commodore 64
Publisher: Electronic Arts
2755 Campus Drive
San Mateo, CA 94403
Medium: Disk



Music Construction Set makes creating music on the 64 easy.

MCS. These three initials can stand for a number of things: My Computer System or perhaps Mortimer's Cadillac Sales. While anything is possible, *MCS* in this case stands for Electronics Arts' groundbreaking *Music Construction Set* .

Whether considered an educational, entertainment or even a productivity program, *MCS* represents a frontier in home computing.

As with their other offerings, Electronic Arts sells the program (disk and manual) in a distinctive pseudo-record album package. Not only is it attractive, it's practical too! Three or four programs take up no more shelf space than one regularly boxed. Storage space can be an issue at home as well as at the office or retail outlet.

Will Harvey, the youthful (chronologically speaking) author of *MCS* , plays a starring role in the jacket liner notes. After some lighthearted puffery, the notes let the rest of the world know the kind of guy Will really was when he wrote the program; a 4.0 football-playing, student body president at Uplands High School in Foster City, California. After using *Music Construction Set* just once, you'll believe every word.

So much for charisma and cosmetics, the code is what counts. That and the documentation, of course.

A 13-page semi-gloss manual entitled "The Manual" is included in the album along with a six-sided, foldout reference card. (Yes, the program disk is there too.)

Though there are many facets to this fascinating and powerful program, the basics can be readily mastered. It's the nuances which take time—time well spent, I might add. Music really excells because the hardware itself has such great musical capabilities, which are unleashed by *MCS*.

In order to follow "The Manual," it helps to read the reference card, so let's check it out.

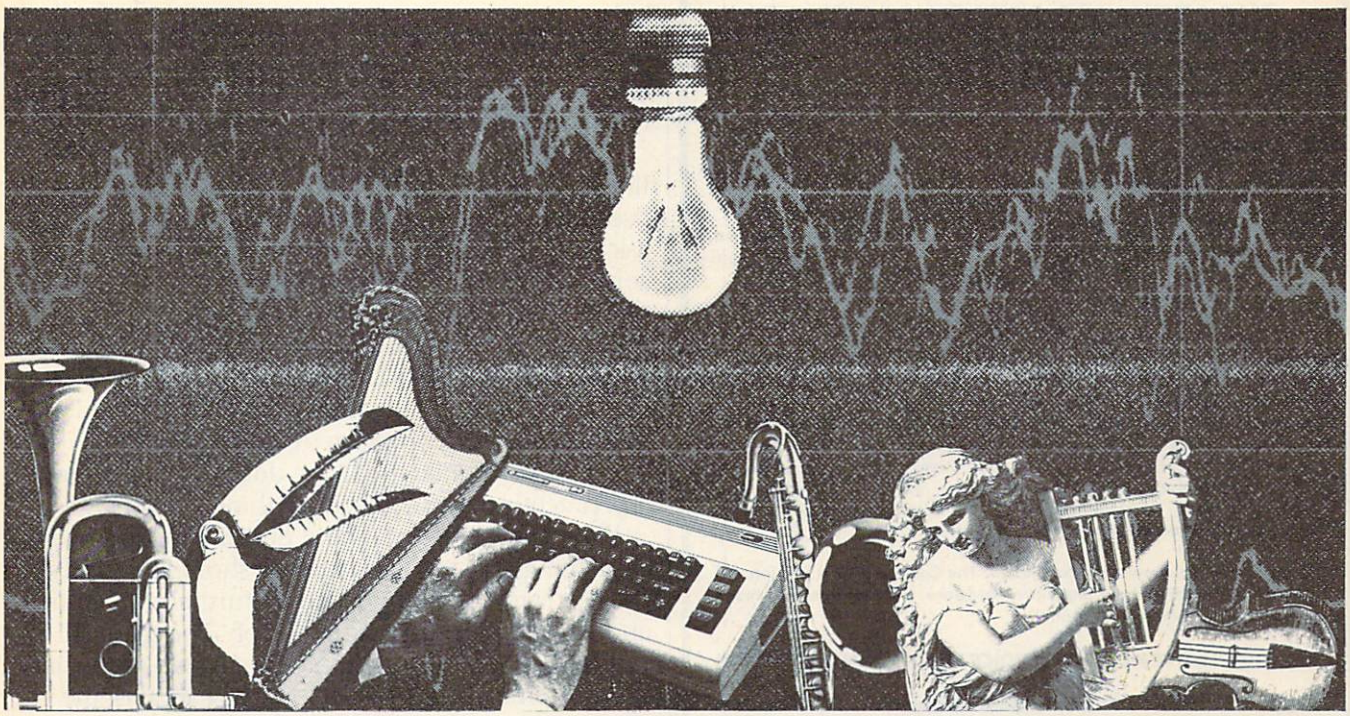
After the disk loading instructions, a table of contents lists the musical compositions preprogrammed on the floppy. Thirteen titles, ranging from original pieces such as Douglas Fulton's "Opera" and "Tears on My 64" to classics like "Scherzo" by Felix Mendelsohn and "Bumblebee" (Flight of the) by Rimsky-Korsakov can be selected for your listening pleasure. (Douglas Fulton, by the way, is the man responsible for arranging and adapting the *MCS* music to a computer format, among other things.)

The next section outlines the various controls, aids and procedures used to construct music. The onscreen icons are displayed next to a written description of each command's function and consequence. This way, there's no (not much anyway) room for user error.

Right off the bat, one learns that *MCS* input can be accomplished through the keyboard, with a KoalaPad or a joystick. Sometimes a combination of keystrokes and the other two is the best.

By using the pointing-hand icon in conjunction with the RETURN key, it is possible to activate the other functions as well as maneuver the various notes, sharps, flats and miscellaneous musical notations on the two staffs.

To play the prerecorded or self-composed music, merely engage the piano icon. Directional arrows provide fast forward and reverse modes of travel through the horizontally scrolling measures. The HOME key automatically returns the composition to its initial starting place. Disk access is handled through an icon facsimile of a floppy. With a



formatted disk, it's possible to save and load original or altered constructions; the latter can be created from the pieces included with *MCS* itself. Storage capacity, though limited, should be sufficient for most uses. Approximately 20 pieces of up to 700 measures each can be packed onto each floppy.

By the way, a sidebar routine in *MCS* called Mystery Melodies works as a computerized "Name That Tune." Ten popular melodies stripped to their rhythmic basics are included. While all the notes and accidentals (rests and sharps) are in their proper order, they all reside on a single line or space. Guessing a song's title takes a good memory, a little work and considerable musical trivia knowledge. Try it at a party; you'll be glad you did!

The Cut-and-Paste editing features are about the most powerful and useful items in the program. With them, segments can be put into a buffer and reproduced at different locations on either staff.

Music Construction Set goes allegro with the next commands. Playback speed, volume control and sound quality are all independently controllable through five gauges visible onscreen at all times. Speed can be changed from the pace of molasses in January to something approximating the velocity of the space shuttle in orbit. This flexibility comes in very handy when fine-tuning a composition. The volume control is self-explanatory. Unfortunately, separate regulation of the upper and lower staffs is not permitted.

Now, the best for last. Sound quality, in my opinion, is a misnomer for much of what this function actually does. While it adds synch and ring modulation to the playback mode (refer to the 64's owner manual for more information on those two topics), its primary utility lies in the reproduction of the musical essence of numerous instruments.

Each staff can be independently programmed to sound like an oboe (two variations), a flute, a harpsichord (full-bodied or muted), an organ or an accordion. Brass and percussion are included as well as a hand-clapping routine for a hoedown effect. It's almost like having an orchestra at home! Don't forget, the 64 can be linked to a quality stereo system for enhanced enjoyment of its audio antics.

A time signature control sets the playback speed to match the speed a piece is written in. As an aid in debugging or eliminating problems, a beat counter identifies measures containing too many or too few beats.

Notes are not indicated onscreen for each line and space. While this may not be a drawback for a musician, it can be quite a barrier to the neophyte. Thankfully, a note indicator alleviates the problem by displaying the note alphabetically onscreen and producing the corresponding tone. It also eliminates the need to keep checking a book for clues as to a note's whereabouts.

Compositions can be transposed between different keys; the computer will handle rewrites to keep the pieces musically correct. Adding rests, octave raises, dots and ties and performing clef changes can all be done with just a quick point and press or a few keystrokes. Even thirty-second notes and rests are available.

It's also possible to dump your masterpieces to a graphics printer such as the 1525 or a suitably interfaced dot-addressable unit. Budding entrepreneurs could use *MCS* to create original music and then print it as commercially-marketable sheet music.

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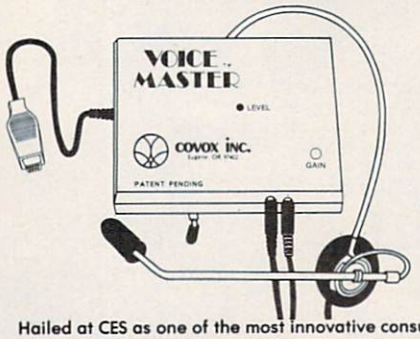

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While this may appear to be magic, it's not. (At least that's what the *MCS* pixie told me.)

All these wonderful things can be done with just a limited investment of time and money. However, users are going to make mistakes. What you might ask is, what does *MCS* do for people who find themselves in that unwelcome predicament? No, it doesn't shut down and refuse to work anymore. On the contrary, it provides audio error messages in the form of short beeps. This feedback indicates that one of six outlined errors has been performed on the unsuspecting program by an equally unsuspecting and most likely dumbfounded fine arts practitioner. Luckily, everything's reversible.

Except for a few odds and ends in the command area, the gist of *MCS* 's structure should be pretty evident at this point. What needs further exploration and explanation is the contents of "The Manual".

After a brief introduction to the world of music, the pamphlet delves into a look at several of the more commonly used commands. A primer on the use and relationships between notes, rests, dots, ties, staffs and clefs comprises the next few pages. The construction and importance of chords is touched upon; then the concept of major and minor keys is sketched out.

The final page and a half asks and then answers some practical questions. Others which might crop up have to be handled through increased experience or by tapping another source of musical knowledge. A diagram on the back cover depicts and identifies the icons, gauges and controls as seen onscreen during use. Until you're familiar with the video layout, keep this nearby.

MCS is intriguing on several levels. Educationally, it can be a supplement to grade- or high-school level instruction. It can also do a fine job reacquainting someone with concepts and ideas they may have forgotten.

On the entertainment front, the "Mystery Melody" and preprogrammed tunes can be listened to for fun. Even the activity needed to master the program can be an enjoyable experience. In addition, *MCS* 's unique capabilities make it the ideal tool for musical experimentation and alteration. Coupled with hard copy availability, rewrites of sheet music become a snap. A choir could probably make extensive use of it.

While the program can't handle overly complex compositions, it's still very flexible and powerful. Besides the aforementioned categories, no one can tell what *MCS* will be used for in the future by some innovative, creative individual.

Easy to use, finely crafted and well documented, *Music Construction Set* rates only the highest of recommendations. **C**

Studio 64 and Add Mus'in

Reviewed by Jaime Wilcutt

Computer: Commodore 64
Publisher: Entech
P.O. Box 185
Sun Valley, CA 91353
Medium: Disk

Entech Software's music package, contains both *Studio 64* and *Add Mus'in* is an excellent tool for adding music to your own BASIC programs without having to be lucid with SID.

Although this program does not fully utilize the SID chip's full potential, it does use what is necessary for basic sound synthesis: three voices, waveforms, envelopes (ADSR), pulse widths and the three SID chip filters with cutoff frequency and resonance control.

Entering Music

Pitches are entered one voice at a time in a piano keyboard style using the second and third rows on the 64 keyboard. Although the keyboard spans only one octave and a fifth, each note's octave (one to eight) can be selected and is numerically indicated at the top of the screen.

The note has an initial duration of a sixteenth ( ) and its value is increased by an additional sixteenth with each striking of the key. (1 strike = , 2 strikes = , 3 strikes = , etc.). Rearticulation of the note is accomplished by a different keystroke. Rest durations are achieved in the same manner.

Music can also be entered in a real time mode. In this mode, when a key is struck, the computer will add duration to the note until another key is struck. This process also applies to rests.

The real time mode is, however, a bit awkward to control if you are used to the response of regular keyboard instruments. This is partly due to the fixed rate at which this mode processes keyboard input (120 mm). The rate may be changed by using the F6 key. This mode can be useful in a recitative style or in an improvisory or chance structure.

Pitch and waveform are added at the same time, the latter being indicated in the upper left corner of the screen. This allows the waveform to be changed with every pitch change, if desired. This increases the creative potential of the program. The ability to change the sound color with each note allows greater flexibility in arranging music and orchestration. I found experimenting with these color options intriguing.

Playing Music

Music can be played during the process of entering notes or after completion of the piece. The tempo can be set and should be reset after changing voices or modes. The screen will display only one voice at a time, although all three voices can be accessed while entering music (but only one beat at a time).

It is easy to add material to a line, then play all entered material to that point. In fact, the quickest way to check entered material is by playing through it, since the total written score is only available one beat at a time.

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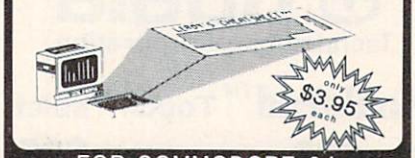

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Editing

Editing in *Studio 64* is easy—you can move through the score of any voice, deleting and inserting material. Also, blocks of score can be cut and pasted one voice at a time. If there is a repeated line, for example, it can be duplicated easily. These blocks can only be moved forward and cannot be moved backward toward the beginning.

Because pitch, duration, octave and waveform must be entered before moving onto the next note, it is not possible to edit one of these elements without involving the others.

Envelope and Pulse Width Mode

The envelope (ADSR) and the pulse width settings are displayed by vertical bar graphs and are easily changed with the use of the function keys of the 64.

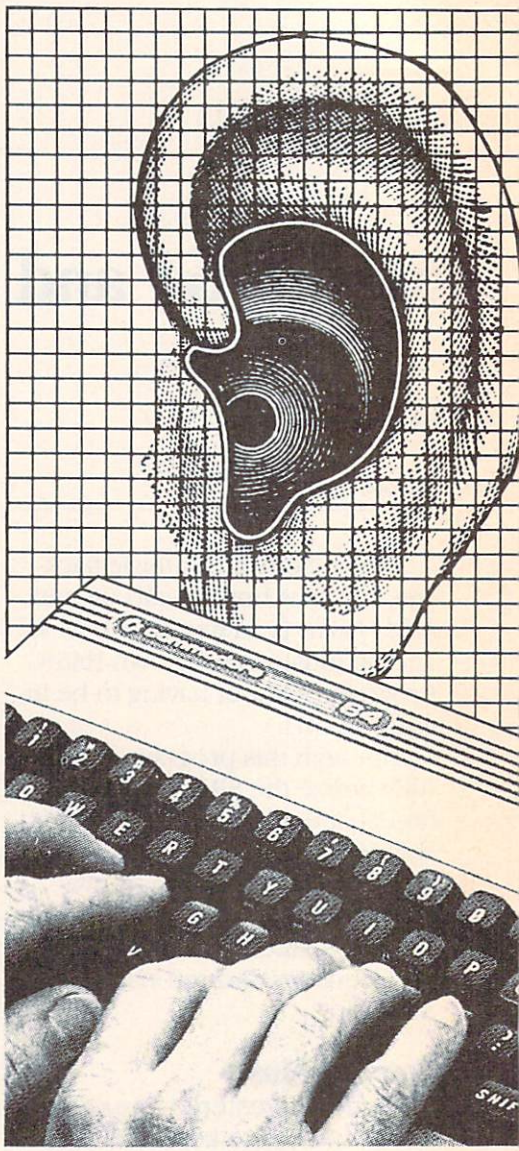
Music cannot be played while in the envelope/pulse width mode. However, getting to and from the play mode is simple, allowing you to hear promptly any changes you make. This makes experimentation easy, an educational plus for the novice synthesist.

The individual lines cannot be played separately, so you must listen closely to the line on which you are experimenting. It is important to hear the interaction of envelope settings, since this has an effect on the rhythmic precision of a composition.

Filtering Mode

One of the most important elements in sound synthesis is the filtering system. *Studio 64* employs all three SID filters. The program allows you to choose which voice or voices you want to filter and which filters you wish to use.

After selecting voice(s), a test tone is sounded. (Make sure there is some sustain setting in the envelopes or the test tone will not be continuous.) The octave and waveform of the test tone can be changed before setting the cut-off frequency and resonance.



Once these settings are completed, the computer can be tuned to another instrument such as a piano. This is a very convenient option when playing or recording with other sound sources.

If you return to the filtering mode at any time to test cut-off frequency or resonance, you are trapped until you answer (or reanswer) the program's questions about use of filters with voices. This can be time-consuming and does not allow fluid movement within the program.

Notation Graphics

Notation is made on a staff using bass or treble clef, but only within the compass of the keyboard as previously discussed. There are not bar lines or time signatures, so these traditional scoring guides are unavailable. This is, however, preferable to a fixed bar line system of some music programs. This can crowd up to sixteen 1/16 notes into a small space, creating a blur of high-resolution graphics.

The notes of *Studio 64* are easy to read and look like traditional printed notation, although there is no proportional spacing.

Since there are no key signatures, all accidentals are specifically indicated. Both flats and sharps are used, but not in the traditional key-oriented manner. (It would be better to use either all sharps or all flats, rather than a non-traditional mix.)

The notation system is the weakest part of *Studio 64* , but if one has a good ear or two, the notation can be a helpful guide.

Save and Load

When a piece is completed, it can be saved to disk or tape. Then each of the three lines of the score can be erased and a new composition started. A line can be cleared completely on the command SHIFT/DELETE, but before it is erased, the program asks if you are sure you want to delete it. This is an excellent safeguard, preventing an entire line from being accidentally erased. (There were a few times I was very thankful for this. There is little worse than losing a great deal of data by accident.)

The saved composition can be loaded from disk or tape. Loading a new composition will clear all other music from memory.

In summary, *Studio 64* is a basic sound synthesizing program which takes a short time to learn. Once familiar with the program, you can bounce in and out of the different modes. (There is a help screen which facilitates the learning process.)

Despite its weaknesses (some of which can be overcome with a few tricks), Studio 64 is a good program for experimenting with and learning about sound synthesis. Coupled with *Add Mus'in* you have a great combination for programmer and musician.

Add Mus'in

Add Mus'in converts anywhere from one to 30 of the pieces you have saved using *Studio 64* into a machine language file. Then, by adding the Loader program to the beginning of your own program, you can access any one of the thirty pieces using a few simple commands.

The applications are obvious to anyone who has wanted to compliment the graphics and layout of a program with sound and music. Many people are not familiar enough with the SID chip to add sound to their own programs. *Add Mus'in* gives that programmer the opportunity to experiment.

This can be a valuable tool for the musician, since it allows for the development of a musical form program. Such a program can provide choices of material and the ability to cue that material at anytime. This is important when recording with other instruments.

The documentation, which is clearly written, states that the Loader program is under copyright protection. If it is used in a commercial program, a license must be issued by Entech Software. This can be obtained for a nominal registration cost by contacting Entech.

Studio 64 and *Add Mus'in* are very useful tools. Despite weaknesses, they can provide a new dimension to your programming. C

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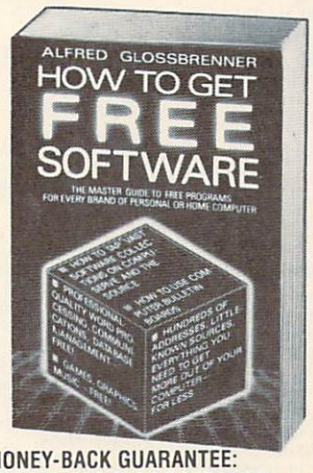

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Because our user group listing has become excessively long, we are now publishing only a partial list in each issue. This time we've included all our user groups in states beginning with letters N through W and all foreign groups. Next issue we'll publish all the groups in states beginning with letters A through M. Then the following issue, it's back to N through W, and so on, until we get so many that we have to publish it in three — or four — or more — parts.

NEBRASKA

1629 Boise
Alliance, NE 69301
Marilyn Sallee

Greater Omaha
Commodore 64 Users Group
2932 Leawood Dr.
Omaha, NE 68123
Bob Quisenberry
(402) 292-2753

Pathfinders 64
1812 North 1 St.
Fremont, NE 68025
Kent Tegels

Platte Valley
Commodore User Group (PVCUG)
1720 - O - St.
Gering, NE 69341
Jim Parks
(308) 436-3211

NEW HAMPSHIRE

C-64 U.S.E.R.S.
User Software Exchange Pro
P.O. Box 4022
Rochester, NH 03867

Northern New England
Computer Society
P.O. Box 69
Berlin, NH 03570

TBH VIC-NICs
P.O. Box 981
Salem, NH 03079

NEW JERSEY

ACGNJ PET/VIC/CBM User Group
30 Riverview Terr.
Belle Mead, NJ 08502
J. M. Pylka
(201) 359-3862

Bordentown Area
Commodore Users Group
10 Spring St.
Bordentown, NJ 08505
Joe Griner
(609) 298-6275

Cape-Atlantic
Commodore Users Group
1515 Shore Rd.
Lincoln, NJ 08221
B.J. Chadwick
398-4044

Commodore Friendly User Group
49 Hershey Rd.
Wayne, NJ 07470
Rich Pinto/Colin Campbell
(201) 696-8043

Cumberland County
Commodore Users Group
28 Parker St.
Bridgeton, NJ 08302
William Fleming
(609) 451-7793

Educators Advisory
P.O. Box 186
Medford, NJ 08055
John Hanfield
(609) 953-1200

Ewing Commodore Users Group
11 Van Saun Dr.
Trenton, NJ 08628
John C. Jones
(609) 882-4826
last Wed. of month 7-9 p.m.

INFO 64
16 W. Ridgewood Ave.
Ridgewood, NJ 07450
Dave Garaffa
(201) 447-4422

Jersey Shore
Commodore Users Group
Wall Township First Aid Building
1905 Monmouth Blvd.
Wall Township, NJ
Bob McKinley (201) 542-2113
G Decker 223-1387
3rd Thurs of month @ 7

Monmouth Commodore/PET Users
Club
25 Fox Wood Run
Middleton, NJ 07748
Stan Gawel
(201) 671-4059

Morris Area
Commodore Users Group (MACUG)
61 Early St.
Morristown, NJ 07960
Tom Limoncelli
(201) 267-5088

Parsippany Computer Group
51 Ferncliff Rd.
Morris Plains, NJ 07950
Bob Searing
(201) 267-5231

Rancocas Valley Users Group
P.O. Box 234
Mt. Laurel, NJ 08054
M. Eisenbacher
(609) 267-1912
4th Tues. 7pm

Somerset Users Club
49 Marcy St.
Somerset, NJ 08873
Robert Holzer

South Jersey
Commodore Users Club
P.O. Box 4205
Cherry Hill, NJ 08034
Fred Herrmann
(609) 227-7905

The Bell Communication Research
Commodore Users Group
Rm. 17-32 2883
Basking Ridge, NJ 07920
Walter Hobbie
(201) 221-4427

The North American
Commodore Teachers U.G.
51 Ferncliff Rd.
Morris Plains, NJ 07950
Bob Searing

VIC 20 User Group
67 Distler Ave.
W. Caldwell, NJ 07006
G. M. Amin
(201) 284-2281

VIC Software Development Club
77 Fomalhaut Ave.
Sewell, NJ 08080
H. P. Rosenberg

VIC-TIMES
46 Wayne St.
Edison, NJ 08817
Thomas R. Molnar

NEW MEXICO

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Albuquerque, NM 87109
Danny Byrne
(505) 821-5812

Southern New Mexico
Commodore Users Group
P.O. Box 4437
Las Cruces, NM 88001
David Selwyn
(505) 522-7622

NEW YORK

505-84-6667 E-3S 5th Gen. Hosp.
APO New York, NY 09154
Gary Lee Crowell

Long Island PET Society
Harborfields HS
Taylor Ave.
Greenlawn, NY 11740
Ralph Bressler

Adirondack
Commodore 64 Users Group
205 Woodlawn Ave.
Saratoga Springs, NY
Paul Klompas
(518) 584-8960

Bayside VIC Users
23-20 Bell Blvd.
Bayside, NY 11360
Marc Gerstein

Brooklyn Bytes
10805 Flatlands 9th St.
Brooklyn, NY 11236
Bruce Gittman
1st Tuesday of month

Capitol Dist.
64/VIC 20 Users Group
363 Hamilton St.
Albany, NY 12210
Bill Pizer
(518) 436-1190

Chautauqua County
Commodore Users Group
c/o Sector One Computer
19-21 East Main St.
Westfield, NY 14787
Mark Dunlap
(716) 326-2222

Commodore 64 Berlin Users Group
Co. B USAFS Berlin
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APO New York, NY 09742
Charles D. Blagburn

Commodore 64 Users Group
67-42 Harrow St.
Forest Hills, NY
Sam Soltan

Commodore Computer Club
Publications Dept.
1111 Stewart Ave.
Bethpage, NY 11714
Neil Threulsen
(516) 575-9558

Commodore Computer
Users Group Heidelberg
P.O. Box
APO New York, NY 09102
Robert H. Jacquot

Commodore Masters
25 Croton Ave.
Staten Island, NY 10301
Stephen Farkouh

Commodore Sig Computer
Club of Rockland
P.O. Box 233
Tallman, NY 10982
Peter Bellin
(914) 357-8941

Commodore 64 Users Group
S.U.N.Y. at Oswego
Dept. of Industrial Arts
Oswego, NY 13126
John R. Boronkay

Computer Club of Rockland
P.O. Box 233
Tallman, NY 10982
Ann Ney 357-7937

Finger Lakes
Commodore Users Group
c/o Rose City Computer Associates
229 West Union St.
Newark, NY 14513
(315) 331-1185

Hello
76-12 35th Ave.
Jackson Heights, NY 11372
Jared Sherman

Hudson Valley Commodore Club
P.O. Box 2190
Kingston, NY 12401
1st Wed. of month

L&M Computer Club VIC 20 & 64
4 Clinton St.
Tully, NY 13159
Dick Mickelson
(315) 696-8904

LIVE (Long Island VIC Enthusiasts)
17 Picadilly Rd.
Great Neck, NY 11023
Arnold Friedman

LIVICS (Long Island VIC Society)
20 Spyglass Lane
East Setauketm, NY 11733
Lawrence Stefani
(516) 751-7844

Manhatten 64
c/o Steve Lazarowitz
1440 Freeport Loop
Brooklyn, NY 11239
Larry Thompson
(212) 647-4266

Merrick Comm dore Club
2158 Vine Dr.
Merrick, NY 11[illegible]56
Howard Miller

Mohawk Valley Commodore Users
Group
P.O. Box 343
Tribes Hill, NY 12177
William Nowak
(518) 829-7576
2nd Tues. of month @ 7 p.m.

Naples Commodore Users Group
P.O. Box 11
FPO, NY 09521
Donald Schmidt

New York 64 Users Group
222 Thompson St.
New York, NY 10012
Bruce Cohen
(212) 673-7241

New York
Commodore Users Group
380 Riverside Dr.
New York, NY 10025
Ben Tunkelang
(212) 566-6250

Norny Chug
P.O. Box 226
Norwood, NY 13668
Andrew VanDuyne
353-4591
2nd Wed. of month @ 7 p.m.

Poughkeepsie VIC User Group
2 Brooklands Farm Rd.
Poughkeepsie, NY 12601
Joe Steinman
(914) 462-4518

PET User Club of Westchester
P.O. Box 1280
White Plains, NY 10602
Ben Meyer

Queens N.Y. Users Group
67-42 Harrow St.
Forest Hills, NY
Sam Soltan

Rockland County
Commodore Users Group
P.O. Box 573
Nanuet, NY 10965
Ross Garber

SCUG
(Schenectady Commodore
Users Group)
c/o The Video Connection
Canal Square
Schenectady, NY 12305
Timothy Davis
1st Mon. of month

SPUG
4782 Boston Post Rd.
Pelham, NY 10803
Paul Skipski

The Commodore
Users Group Rochester
78 Hardison Rd.
Rochester, NY 14617
Tom Werenski
(716) 544-5251
Phone Evenings between 7-10

The New York City
VIC/64 Users Group-NYCUG
436 East 69th St.
New York, NY 10021
Joycelyn Woods
(212) 787-2854

The Upstate
Commodore Users Group
P.O. Box 5242
Arnot Mall
Horseheads, NY 14844
Chris Johnson

Utica Commodore Users Group
1801 Storrs Ave.
Utica, NY 13501
Phil Rothstein
(315) 733-2244

VIC 20 User Club
339 Park Ave.
Babylon, NY 11702
Gary Overman
(516) 669-9126

VIC 20 User Club
151-28 22nd Ave.
Whitestone, NY 11357
Jean F. Coppola

VIC 20 User Group
Paper Service Division
Kodak Park
Rochester, NY 14617
David Upham

VIC 20/64 Users Group
31 Maple Dr.
Lindenhurst, NY 11757
Pete Lobol
(516) 957-1512

VIC 20/64 Users Group
NYU
Waverly Place
New York, NY 10003
Lawrence Schulman
(212) 358-5155

VIC Information Exchange Club
336 W. 23 St.
Deer Park, NY 11729
Tom Schiegel
SASE & ph. pl.

VIC User Group
1250 Ocean Ave.
Brooklyn, NY 11230

Dr. Levitt
(212) 859-3030

VIC Users Club
76 Radford St.
Staten Island, NY 10314
Michael Frantz

VIC Users Group
c/o Stoney Brook Learning Center
1424 Stoney Brook Rd.
Stoney Brook, NY 11790
Robert Wurtzel
(516) 751-1719

West Chester County
VIC Users Group
P.O. Box 146
Pelham, NY 10552
Joe Brown

NEVADA

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Reno, NV 89570
Franklin Miller

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Los Vegas, NV 89109
Cindy Springfield
(702) 369-7354

Las Vegas PET Users Group
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5130 E. Charleston Blvd.
Las Vegas, NV 89122
Gerald Hasty

Southern Nevada
Commodore Group
905 Biljac St.
Las Vegas, NV 89128
Joseph Windolph
363-2519

SOG Commodore Users Group
c/o IC Electronics
4011 W. Charleston Blvd.
Las Vegas, NV 89102
Dave Gorking
(702) 870-4201

NORTH CAROLINA

Cleveland County Computer Club
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Grover, NC 28073
Todd Patterson
(704) 937-9124

Down East
Commodore Users Group
302 Belltown Rd.
Havelock, NC 28532
Bruce Theden
(919) 447-4536

Microcomputer Users Club
Box 17142 Bethabara Sta.
Winston-Salem, NC 27116
Joel D. Brown

Raleigh VIC 20/64 Users Group
410-D Delta Court
Cary, NC 27511
Larry Diener
(919) 469-3862

Tryon Commodore 64 Club
P.O. Box 1016
Tryon, NC 28782
Robin Michael
(704) 859-6340
1st Mon. of month at 7 p.m.

VIC Users Club
Rt. 11
Hickory, NC 28601
Tim Gromlovits

VIC Users Club
Route 3
Lincolnton, NC 28092
David C. Fonenberry

NORTH DAKOTA

CCCC (Capitol City Computer Club)
c/o Veterans Memorial
Public Library
520 Avenue A East
Bismarck, ND 58501
Rolf Arnold

The Computer Club
Lock Drawer 1497
North Dakota State Penitentiary
Bismarck, ND 58502
Ed Reitan

OHIO

11433 Pearl Rd.
Strongsville, OH 44136
Paul M. Warner

Akron Area C-64 Users Group
2453 Second St.
Cuyahoga Falls, OH 44221
Paul Hardy
(216) 923-4396
4th Sat. of month @ 1-4pm

C.P.U. Connection
P.O. Box 42032
Brook Park, OH 44142
Danni Hudak

Central Ohio
Commodore Users Group
107 S. Westmoor Ave.
Columbus, OH 43204
Phillip H. Lynch
(614) 274-0304

Chillicothe
Commodore Users Group
P.O. Box 211
Chillicothe, OH 45601
William A. Chaney

Commodore Local Users Exchange
(C.L.U.E.)
3040 Highcliff Ct.
Columbus, OH 43229
Pat Murphy
2nd mon. of month @ 6

Commodore Users of Blue Chip
(Cincinnati)
816 Beecher St.
Cincinnati, OH 45206
Ted Stalets
(513) 961-6582

Commodore Users Group
18813 Harlan Dr.
Maple Heights, OH 44137
Carl Skala
(216) 581-3099

Dayton Area
Commodore Users Group
679 Murray Hill Dr.
Xenia, OH 45385
Charles Tobin
(513) 372-4077

Licking County 64 Users Group
323 Schuler St.
Newark, OH 43055
(614) 345-1327

MarionOhio
Commodore Users Group (MO-CUG)
775 Wolfinger Rd.
Marion, OH 43302
Van Munro
(614) 726-2630

Medina Commodore Users Group
P.O. Box 182
Medina, OH 44258
Jill Carpenter
(216) 722-2611
2nd Wed. @ 7 p.m.

S.W.O.C.U.G.
(SW. Ohio Commodore Users Gp.)
8401 Wicklow Ave.
Cincinnati, OH 45236
Joe Beresford

Southwestern Ohio
Commodore Users Group
P.O. Box 399117
Cincinnati, OH 45239
2nd Wed. of month at 7 p.m.

OKLAHOMA

Commodore Oklahoma Users Club
4000 NW 14th St.
Oklahoma City, OK 73107
or call
Stanley B. Dow
(405) 943-1370

Commodore Users
Box 268
Oklahoma City, OK 73101
Monte Maker

Commodore Users of Bartlesville
1704 S. Osage
Bartlesville, OK 74003
Fred Mayes
(918) 336-0233

Commodore Users of Norman
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Noble, OK 73068
Matt Hager

Commodore Users Group
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Muskogee, OK 74401
Steve Ford

Greater Oklahoma
Commodore Club
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Oklahoma City, OK 73127
Randy Hill
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Southwest
Oklahoma Computer Club
c/o Commodore Chapter
P.O. Box 6646
Lawton, OK 73504
meets 1

Tulsa Area
Commodore Users Group
7804 N. 117th E. Ave.
Owasso, OK 74055
Craig Bowman
(918) 272-9755

OREGON

Jefferson State
Computer Users Group-JUG
2355 Camp Baker Rd.
Medford, OR 97501
John Newman

NW PET Users Group
2134 N.E. 45th Ave.
Portland, OR 97213
John F. Jones

Southern Oregon
VIC/64 Users Group
3600 Madrona Lane
Medford, OR 97501
James Powell
(503) 779-7631

United States
Commodore Users Group
P.O. Box 2310
Roseburg, OR 97470
Richard Tsukiji
(503) 672-7591

US Commodore Users Group
1385 Cleveland Loop Dr.
Roseburg, OR 97470
Richard Tsukiji

PENNSYLVANIA

4820 Anne Lane
Sharpsville, PA 15150
Gene Planchak
(412) 962-9682

812 Eight Squared
Mindy Shelton
P.O. Box 76
Mount Holly Springs, PA 17065
(717) 766-5185 or
(717) 486-3274

A-K 64 Users Group
1762 Fairmont St.
New Kensington, PA 15068
Alton E. Glubish
(412) 335-9070
2nd & 4th Tues. of month

Bellwood - Altoona Users Group
1433 - 13th Ave.
Altoona, PA 16603
D.N. Dantof
(814) 942-9565

Bits & Bytes
1015 Dale Rd.
Secane, PA 19018
Dave Boodey
(215) 544-5875

Boeing Employees
Personal Compute Club
The Boeing Vertol Co.
P.O. Box 16858
Philadelphia, PA 19142
Jim McLaughlin
(215) 522-2257

Castle Commodore Computer Club
RD #1
Edinburg, PA 16116
D. Wade (216) 673-9261
3rd Thursday

Cliftin Heights Users Group
P.O. Box 235
Clifton Heights, PA 19018

Commodore Users Group
781 Dick Ave.
Warminster, PA 18974
Matt Matulaitis

Commodore Users Group
3021 Ben Venue Dr.
Greensburg, PA 15601
Jim Mathers
(412) 836-2224

CACC
(Capitol Area Commodore Club)
P.O. Box 333
Lemoyne, PA 17043
Geoffrey Hebert
(717) 732-5255

CACCC-Centre Area
Commodore Computer Club
214 Computer Building
University Park, PA 16802
Bill Hillner
(814) 237-5912

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Mike Norm
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Bill Bolt

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NADC Commodore Users Club
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Norman McCrary

Oxford Circle 64 User Group
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6900 Rising Sun Ave.
Philadelphia, PA 19111
Roger Nazeley (215) 535-9021
(215) 743-8999
3rd Mon. of month 7

Penn Conference Computer Club
c/o Penn Conference of SDA
720 Museum Rd.
Reading, PA 19611
Dan R. Knepp

PACS Commodore Users Group
LaSalle College
20th & Olney Ave.
Philadelphia, PA 19141
Stephen Longo
(215) 951-1258

PET User Group
P.O. Box 371
Montgomeryville, PA 18936
Gene Beals

PPG (Pittsburgh PET Group)
2015 Garrick Dr.
Pittsburgh, PA 15235
Joel A. Casar
(412) 371-2882

Scranton Commodore Users Group
P.O. Box 211
Clarks Summit, PA 18411

The Commodore Users Club
of S.E Pittsburgh
c/o Groves Appliance & TV
2407 Pennsylvania Ave.
West Mifflin, PA 15122
Charles Groves

Upper Buxmont C-64 Users
655 Bergey Rd.
Telford, PA 18969
Don Roques (215) 723-7039

VIC 20 Programers
c/o Watson Woods
115 Old Spring Rd.
Coatesville, PA 19320
Robert Gougher

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440 W. Sedgwick Apt. A-1
Philadelphia, PA 19119
Tracy Lee Thomas
(215) 844-4328

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Commodore Users Group
P.O. Box 995
Williamsport, PA 17703
Gene Loveland
(717) 323-7901

Westmoreland Commodore Users Club
c/o DJ & Son Electronics
Colonial Plaza
Latrobe, PA 15650
Jim Mathers

Worldwide
Commodore Users Group
P.O. Box 337
Blue Bell, PA 19422
David Walter

PUERTO RICO

Commodore Users Group of Ponce
BP5 Ext. Las Delicias
Ponce, PR 00731
(809) 844-5733

CUG of Puerto Rico
RFD #1
San Juan, PR 00914
Ken Burch

VIC 20 User Group
655 Hernandez St.
Miramar, PR 00907
Robert Morales

RHODE ISLAND

Commodore Users Group
c/o Data-Co.
978 Tiogue Ave.
Coventry, RI 02816
Victor Moffett
(401) 828-7385

Irving B. Silverman
160 Taunton Ave.
E. Providence, RI 02914
Michelle Chavani

Newport VIC/64 Users
10 Maitland Ct.
Newport, RI 02840
Dr. Matt McConeghy
(401) 849-2684

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(Rhode Island
Computer Enthusiasts)
198 Morris Ave.
Pawtucket, RI 02860
Michael Skelton
(401) 728-8602

SOUTH CAROLINA

Beaufort Technical College
100 S. Ribaut Rd.
Beaufort, SC 29902
Dean of Instruction

Commodore Computer Club
of Columbia
P.O. Box 2775
Cayce
West Columbia, SC 29171
Chuck Howard-Sect./Tres.

Commodore Users
Society of Greenville (CUS)
Horizon Records-Home Computers
347 S. Pleasantburg Dr.
Greenville, SC 29607
Bo Jeanes (803) 235-7922

Spartanburg
Commodore Users Group
803 Lucerne Dr.
Spartanburg, SC 29302
James Pasley
(803) 582-5897

The Charleston Computer Society
P.O. Box 5264
N. Charleston, SC 29406
Jack Furr (803) 747-0310
3rd Tues. of month at 7 p.m

The Executive Touch
C-64 & VIC 20 Users
208 Hwy 15

Myrtle Beach, SC 29577
Patricia Watkins
448-8428

SOUTH DAKOTA

PET User Group
515 South Duff
Mitchell, SD 57301
Jim Dallas
(605) 996-8277

VIC/64 Users Club
608 West 5th
Pierre, SD 57501
Larry Lundeen
(605) 224-4863

TENNESSEE

Commodore User Club
Metro Computer Center
1800 Dayton Blvd.
Chattanooga, TN 37405
Mondays 7

ET 64 Users Group
P.O. Box 495
Knoxville, TN 37901
Walt Turner
(615) 966-8478

Jackson Commodore Users Group
31 Carriage House Dr.
Jackson, TN 38305
Rick Crone
(901) 668-8958

Memphis Commodore Users Club
2476 Redvers Ave.
Memphis, TN 38127
Harry Ewart
(901) 358-5823

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2476 Ridvers Ave.
Memphis, TN 38127
Harry Ewart
(901) 358-5823

Metro-Knoxville
Commodore Users Club
7405 Oxmoor Rd.
Knoxville, TN 37931
Ed Pritchard
(615) 938-3773
2nd Thurs. 6

Nashville Commodore Users Group
P.O. Box 121282
Nashville, TN 37212
Dave Rushing (615) 331-5408
3rd Thurs.at Cumberland Mus

TEXAS

1110 Texas Ave.
Mart, TX 76664
James Meeker
(817) 876-2710

P.O. Box 652
San Antonio, TX 78293
Larry Williams

64 Users Group
2421 Midnight Circle
Plano, TX 75075
Stan Grodin

Commodore Computer Club (C3)
2217 N. Sumner
Pampa, TX 79065
Randy Mills
(806) 665-3444
every other Thurs. 7 p.m.

Commodore Users Group
624 Bellview St.
Sulphur Springs, TX 75482
Danny Miller

Commodore Users Group (Austin)
P.O. Box 49138
Austin, TX 78765
Dr. Jerry D. Frazee

Corpus Christi Commodores
P.O. Box 6541
Corpus Christi, TX 78411
Bob McKelvy
(512) 852-7665

Crossroads
Commodore Users Group
417 Irma Dr.
Victoria, TX 77901
Jerry Guy (512) 575-0342
meets twice a month

CHUG
(Commodore Houston
Users Group)
8738 Wildforest
Houston, TX 77088
John Walker
(713) 999-3650

Gulf Coast
Commodore Users Group
P.O. Box 128
Corpus Christi, TX 78403
Lawrence Hernandez
(512) 887-4577

Interface Computer Club
814 North Sabinas
San Antonio, TX 78207
M.E. Garza

ICUG
(Irving Commodore Users Group)
3237 Northgate #1289
Irving, TX 75062
Robert Hayes
(214) 252-7017

Longview Users Group
P.O. Box 2504
Longview, TX 75606
Joyce Pope
(214) 759-3459

Mid-Cities Commodore Club
413 Chisolm Trail
Hurst, TX 76053
Bruce Nelson, Garry Wordelman

PET User Group
Texas A & M
Microcomputer Club
Texas A & M, TX
John Bowen

Savid Computer Club
312 West Alabama
Suite 2
Houston, TX 77006
Davi Jordan

South Plains '64' Users Group
7709 Avenue 'W'
Lubbock, TX 79423
John N. Bottoms
(806) 745-4381

SCOPE
P.O. Box 3095
Richardson, TX 75083
2nd Sat. of month @ 1

Tarant County
Commodore 64 Club (TCCC)
1901 Lanewood
Fort Worth, TX 76112
Jeff Speed

The Great Northwest
CBM 64 Users Group
6302 War Hawk Dr.
San Antonio, TX 78238
Randy 647-3881

The Woodlands
Commodore Users Group
3 Splitrock Rd.
The Woodlands, TX 77380
Andrew Gardner
(713) 292-8987

VIC 20 Users Group
6416 Brookhaven Trail
Ft. Worth, TX 76133
Jeff Southerland
(817) 346-1407

VIC Users Group
3817 64th St.
Lubbock, TX 79413

UTAH

Mountain Computer Society
P.O. Box 1154
Sandy, UT 84091
Dave Tigner

Northern Utah
VIC & 64 Users Group
P.O. Box 533
Garland, UT 84312
David Sanders

The Commodore Users Club
742 Taylor Ave.
Ogden, UT 84404
Todd Woods Kap

The Commodore Users Group
652 West 700 North
Clearfield, UT 84015
Rodney Keller
(801) 776-3950

The VIClic
799 Ponderosa Dr.
Sandy, UT 84070
Steve Graham

Uintah Basin
Commodore Users Club
P.O. Box 1102
Roosevelt, UT 84066
Terry Hall
2nd & 4th Thursday of month

Utah PUG
2236 Washington Blvd.
Ogden, UT 84401
Jack Fleck

VIC 20 Users
324 North
Smithfield, UT 84335
Dave DeCorso

VERMONT

Burlington Area Commodore Users
Group
6 Mayfair
South Burlington, VT 05402
Steve Lippert
658-4160

VIRGINIA

135 Beverley Rd.
Danville, VA 24541
David Gray

Alexandria Users Group
1206 Westgrove Blvd.
Alexandria, VA 22307
Jeff Hendrickson

Arlington VICtims (20/64)
Fairlington Community Center
4501 Alington Blvd.
Arlington, VA 22204
Clifton M. Gladney
(703) 524-0236
2nd Wed. of month @ 7 p.m.

Capitol Area
Commodore Enthusiasts
P. Henry Library
2312 Tangle Vale
Vienna, VA 22180
Don Swinney
(703) 938-6313
2nd Sat. of month @ 1

Commodore Users of Franklin
1201 N. High St.
Franklin, VA 23851
D. Bruce Powell
(804) 562-6823

Dale City Commodore Users Group
4303 Hemingway Dr.
Dale City, VA 22193
Pat Sullivan
(703) 590-4998

Dale City Commodore Users Group
P.O. Box 2004
Dale City, VA 22193

Franconia
Commodore Users Group
J. Marshall Library
6209 Rose Hill Dr.
Alexandria, VA 22310
Mark Sowash
(703) 971-5021

Frdericksburg Computer Club
P.O. Box 1011
Fredericksburg, VA 22402
Steven Northcutt
(703) 371-4184
Shelkee Asso.

Fredericksburg Area
Computer Enthusiasts
P.O. Box 324
Locust Grove, VA 22508
Michael Parker
(703) 972-7195

Norfolk Users Group
1030 West 43rd St. B-4
Norfolk, VA 23508
Larry Pearson
489-8292

Northern VA PET Users
2045 Eakins Court
Reston, VA 22091
Bob Karpen
(803) 860-9116

NASA VIC 20 User Group
713 York Warwick Dr.
Yorktown, VA 23692
Harris Hamilton

Peninsula
Comodore 64 Users Group
124 Burnham Place
Newport News, VA 23606
Richard G. Wilmoth
(804) 595-7315

PENTAF (Pentagon)
9912 Colony Rd.
Fairfax, VA 22030
Ralph Poole
(703) 273-1337
11

R.A.C.E. Commodore Users Group
4726 Horseman Dr.
Roanoke, VA 24019
Larry Rackow
(703) 362-3960

Tidewater
Commodore Users Group
4917 Westgrove Rd.
Virginia Beach, VA 23455
Fred Monson

VIC 20 Victims
4301 Columbia Pike #410
Arlington, VA 22204
Mike Spengel
(703) 920-0513

VIC Users Group
1502 Harvard Rd.
Richmond, VA 23226
Donnie L. Thompson

VIC Users Group
Rt. 2
Lynchburg, VA 24501
Dick Rossignol

Washington Area C-64 UG (McLean)
c/o Kent Gardens School
7426 Eldorado St.
McLean, VA 22012
Martin Smith
(703) 523-1995
3rd Thurs. of month @ 7 p.m

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Dick Jackson
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Blue Mountain Commodore Users
Club
15 Stone St.
Walla Walla, WA 99362
Keith Rude
(509) 525-5452

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Arlington, WA 98223
Jill Johnston
(206) 435-4580

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1222 S. 1st St.
Yakima, WA 98902
Tim McElroy

Central Washington
Commodore Users Group
P.O. Box 10937
Yakima, WA 98909
Sam Cox
(509) 248-8193

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Seattle, WA 98107
Art Witbeck
(206) 789-2000

CBM Users Group
803 Euclid Way
Centralia, WA 98531
Rick Beaber
(206) 736-4085

Fort Lewis
Commodore Computer Club
Quarters 2821-A
Fort Lewis, WA 98433
Jim Litchfield
(206) 964-1444
1st & 3rd Thurs. @ 7

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Seattle, WA 98109
Richard Bell

PET Users Group
1800 Taylor Ave. N102
Seattle, WA 98102
Kenneth Tong

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(SCUG)
c/o N. 310 Raymond #1
Spokane, WA 99206
Stan White

Whidbey Island
Commodore Computer Club
947 N. Burroughs Ave.
Oak Harbor, WA 98277
Michael D. Clark

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Marc Hutton
(304) 453-2124

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Lewisburg, WV 24901
Chris Apperson
(304) 645-1150

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81 Lynwood Ave.
Wheeling, WV 26003
Alice Shipley
(304) 242-8362

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Logan, WV 25601
C.R. Wilson
1st Tues. of month @ 7 p.m.

Personal Computer Club
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Charleston, WV 25325
Cam Cravens

TriState Commodore Users
73 Pine Hill Estates
Kenova, WV 25530
Marc Hutton
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Commodore Users Club
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Laramie, WY 82070
Pamela Nash
(307) 721-5908

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Caledonia, WI 53108
Jack White
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Racine, WI 53406
Tim Tremmel
(414) 554-0156
3rd Saturday of month

Chippewa Valley
Commodore 64 Users Group
620 West Central St.
Chippewa Falls, WI 54729
Leo Lato
(715) 723-8095

Comm Bay 64
2589 Haven Rd.
Green Bay, WI 54303
Jeff Schwecler
(414) 439-1619

Commodore 64
Software Exchange Group
P.O. Box 224
Oregon, WI 53575
E. J. Rosenberg

CHIPS
1017 Kilbourn Ave.
West Bend, WI 53095
Richard Kohn (E)334-2494
(414) 338-1609 D
2nd Wed. & 4th Thurs.

Eau Claire Area
SPM 64 Users Group
Rt. 5
Eau Claire, WI 54701
John Slavsky
(715) 874-5972
2nd thurs. of month 7 p.m.

Madison Area
Commodore Users Group
1552 Park St.
Middleton, WI 53562
John Carvin
(608) 831-4852
3rd Thurs. each month

Menomonie Area
Commodore Users Group
510 12th St.
Menomonie, WI 54751
Mike Williams
(715) 235-4987

Milwaukee Area CBM64 Enthusiasts (M.A.C.E)
P.O. Box 340
Elm Grove, WI 53122
Kevin Wilde
(414) 259-5991

Project-20
P.O. Box 359
Elm Grove, WI 53122

S.W.I.T.C.H.
W156 N8834 Pilgrim Rd.
Menomonee Falls, WI 53051
Len Lutz
(414) 255-7044

Sewpus
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Milwaukee, WI 53221
Theodore J. Polozynski

The Eau Claire CBM64 Users Group
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Eau Claire, WI 54703
John Slavsky
(715) 874-5972

Vicky Badger Club
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Cottage Grove, WI 53527
George Cooper

VIC-20 & 64 User Group
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Milwaukee, WI 53217
Mr. Wachtl
(414) 476-8125

Waukesha Area Commodore User Group (WACUG)
256 ½ W. Broadway
Waukesha, WI 53186
Walter Sadler
(414) 547-9391

WI Asso. of VIC/64 Enthusiasts (W.A.V.E)
P.O. Box 641
Waukesha, WI 53187
Annette Levandowski
(414) 771-7016
1st & 3rd Fri. @ 7 p.m.

AUSTRALIA

VIC-UPS Computer Users Group
1 Jubilee St.
South Perth 6151
West Australia
Peter Prisgrove
09-367-9505
2nd&4th Tues. at 7

WA VIC-UPS (VIC 20/CBM 64 Users)
14 Glengariff Dr.
Floreat Park 6014
Western Australia
B.J. Cook
09-387-5636

AUSTRIA

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D.A. Stagg
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519-271-5704

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D. Lerch

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Brockville, Canada K6V2X1
Bill Maxwell

C-64 Users Group
P.O. Box 9
Rothesay, Canada E0G2W0
Don Shea

C-64 Users Group of Montreal (C.U.G.O.M.)
Snowdon P.O. Box 792
Montreal, Canada H3X3X9
Gary Letovsky

Calgary Commodore Users Group
37 Castleridge Dr.
Calgary, Canada T3J 1P4
John Hazard

Cambridge Commodore Users Group
c/o Badcock & Wilcox Canaada Ltd.
581 Coronation
Cambridge, Canada N1R5V3
William McLean

Cambridge Commodore Users Group
c/o Badcock & Wilcox Canada Ltd.
581 Coronation
Cambridge, Canada N1R5V3
William McLean

Castlegar Commodore Computer Club
SS1
Castlegar, Canada V1N3H7
Robert Dooley
604-365-3889

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120 Liverpool St.
Fton, Canada E3B4V5
Cass Howorth
506-454-9730

Commodore Computer Club
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West Vancouver, Canada V7V3N6
604-738-3311

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Sudbury, Canada P3A 4K4

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Joel Champagne

Cornwall Computer Club
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Cornwall, Canada K6H2C3
David King

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c/o Strictly Commodore
47 Coachwood Place
Calgary Alberta, Canada T3H1E1
Roger Olanson

COMVIC
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St. Laurent
Montreal, Canada H4L 4Z2

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Barrie, Canada L4M 2E9

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London, Canada N6E1T5
Dennis Trankner
519-681-5059

PET Educators Group
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Station A
Windsor, Canada N9A 6L7

PET Users Club
Valley Heights Secondary School
Box 159
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Mr. Brown

The Regina Commodore Club
76 Dolphin Bay
Regina, Canada S4S4Z8
K.H. Jones
584-2968

Toronto PET Users Group
1912A Avenue Rd.
Toronto, Canada M5M4A1
Chris Bennett416-782-8900
416-782-9252

VIC-TIMS
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Trail British Columb.
Canada V1R3X2
Greg Goss
604-368-9970

W.P.U.G.
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Winnipeg Manitoba
Canada R2V0H9
Larry Neufeld

Nova Scotia Commodore Computer Group
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Halifax South
Halifax, NS
Canada B3J3J1
Phil Cummings

FINLAND

VIC Club in Helsinki
Linnustajankj 2B7
SF-02940 ESPOO 94
Matti Aarnio

HOLLAND

Commodore Users Group
HCC/Venlo
5971 At Grubbenvorst
Holland
Hub Christis

ICELAND

SYNTAX Newsletter
c/o Guomundur Gislason
Bleiksarhlio 4

JAMAICA

VIC 20 Computer Group
21 Lawrence Dr.
Kingston 8, Jamaica
Lancelot Green
809-924-2499

KOREA

Commodore Users Club
K.P.O. Box 1437
Seoul, Korea
S. K. Cha

MEXICO

Association Dr Usuarios Commodore
Holbein 174-6 Piso
Mexico 18, Mexico
Alejandro Lopez Arechiga

Club Microvic
Villaldama 225
Col. Chapultepec
Monterrey, Mexico 66450
Oscar Sosa

Commodore 64 Club
Universita di Studi shan
V. Avigliana 13/1, 10138

Club Herra*Tec C64
c/o Alain Bojmal
Vicente Suarez 25, 06140

Club de Usarios Commodore
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Mol del Valle
Garza Garcia
N.L, Mexico 66220

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Private Bag
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Commodore Users Group
Meet at VHF Clubrooms
Hazel Ave.
Mount Roskill, New Zealand
Roger Altena
278-5262
3rd Wed. of month 7

Nelson VIC Users Group
c/o P.O. Box 860
Nelson, New Zealand
Peter Archer

NORWAY

VIC Club of Norway
Nedre Bankegt 10
1750 Halden, Norway

UNITED KINGDOM

Croydon Microcomputer Club
111 Selhurst
London SE25 6LH
United Kingdom
Vernon Gifford
01-653-3207

North London Hobby Computer Club
Dept. of Electronics & Communication
Engineering Polytechnic of N. London
Holloway Rd., London
N7 8DB United Kingdom

WEST GERMANY

Kettenberg 24
D 5880 Lueden Scheid
West Germany
Rudi Ferrari

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The Trinidad Asso. of Commodore Owners
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Westmoorings/Carenage
Trinidad, West Indies
Mark Mahannah
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Mark Mahannah

User Bulletin Board

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that does not compute

September/October

SuperPET Potpourri

On page 115 at the top we left out the print statement. The first sentence in the first complete paragraph on that page should read: "The complete print statement to my printer, on file #40, is one line: print #40, mat ddate$; mat address$; salutation$; mat letter$; page $"

September/October

Kids Learn with *Frenzy/Flip Flop, Gulp* and *Arrow Graphics*

The author's name not only appeared misspelled in the table of contents, but somehow got separated from the article. The author of this article was Doreen George Carson of Commodore's education software department.

September/October

Editor's Notes

In the fourth paragraph of that article is a reference to the "NAPLYPS" protocols for telecommunications. That should have been "NAPLPS".

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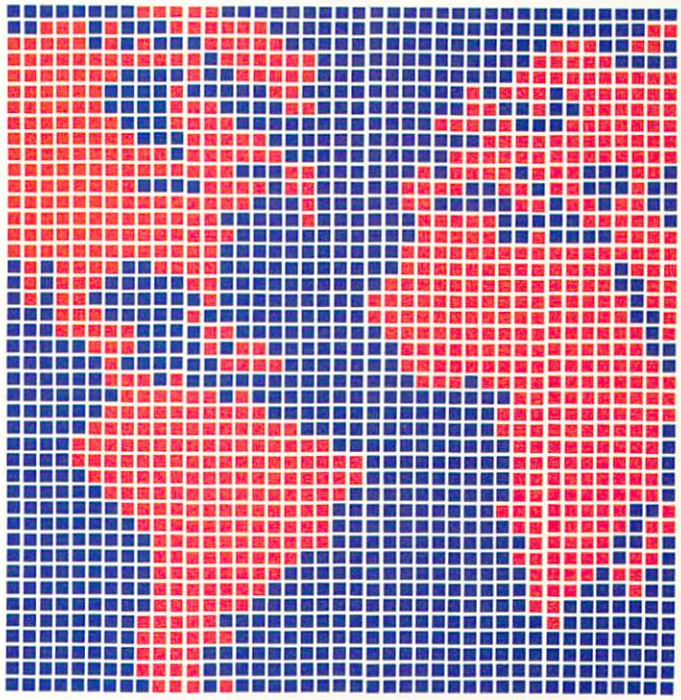

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6:30

MATH FACTS

(Ages 5 to 10) (Micro School) Educational TV. Practice in basic math facts. Several levels. (Easy to hard) (Diskette)

7:00

FRENZY/ FLIP FLOP

(Ages 6 to 14) (Milliken Edufun) FRENZY (subtraction and division) The hungry gator arrives... save the fish... play the BONUS game... FLIP FLOP (transformed geometry) look at the two figures... do they need to flip, turn or slide? (Diskette)

7:30

SOLAR FOX

It's erase or be erased as you navigate spaceship over a grid of colorful pulsating entities, armed with laser. Unlimited levels. A BALLY MIDWAY original. (Cartridge)

8:00

EASY SCRIPT

Our best wordprocessor. Displays 764 lines by 40 characters. Prints over 130 columns. Global/local search/replace/hunt/find. Super/subscripts. Insert/delete characters, lines, sentences, paragraphs. (Diskette)

8:30

THE MANAGER

A powerful database management system. For business, educational or personal files. Not for Rockford's files. With four built-in applications. Or design your own. (Diskette)

9:00

MAGIC DESK I

The scene opens on an office desk, complete with digital clock, typewriter, wastebasket and file cabinet. Select functions (typing, filing, editing) by pointing animated finger (Cartridge)

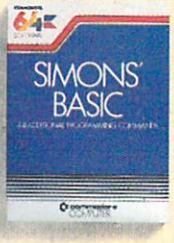
9:30

INTER-NATIONAL SOCCER

(Gold Medallion Game) Sports highlight. With passing, kicking, diving goalies, even trophies! Great color, 3-D realism. No locker room interviews. (Cartridge)

10:00

SIMONS' BASIC



Rated PG. Expands Commodore BASIC by an additional 114 commands. Convenient programming commands such as RENUMBER and TRACE plus graphics plotting command. (Cartridge)

Announcing the most exciting variety show on television.

Featuring many of the stars of arcade games, education and the business world.

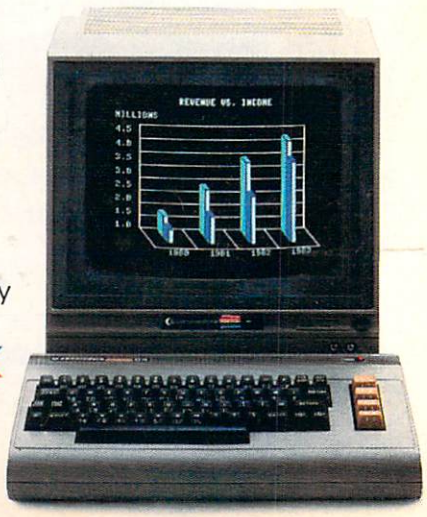
Produced by (and for) Commodore, the people who bring you the Commodore 64™, a 64K computer that would be a value at three times its price. In fact, many of its competitors are three times its price.

Produced in living high resolution graphics with 16 available colors and with eight 3-dimensional sprites.

With a real high fidelity sound that covers a 9-octave range.

And a supporting cast of low-price, high capacity disk drives, printers, monitors (a better way to watch Commodore 64) and modems.

So, if you're not pleased with what's on your tv set tonight, simply turn on your Commodore 64.

COMMODORE 64

IT'S NOT HOW LITTLE IT COSTS, IT'S HOW MUCH YOU GET.